CURRICULUM AND SYLLABUS

CHOICE BASED CREDIT SYSTEM

M.TECH - POWER ELECTRONICS AND DRIVES

(FULL TIME)

I – IV SEMESTERS

SEMESTER I						
Course Code	**Category**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
MMA111	PM	Applied Mathematics	3	2	0	4
MIC105	PC	Advanced Control Theory	3	0	0	3
MPE101	PC	Analysis of Power Converter	3	0	0	3
MPE102	PC	Advanced Semiconductors Devices	3	0	0	3
MPE103	PC	Analysis of Electrical Machines	3	0	0	3
MPE104	PC	System Design Using Microcontroller	3	0	0	3
Total Number of Contact Hours = 20Total Number of Credits= 19						

SEMESTER II						
Course Code	**Category**	**Course Title**	**L**	**T**	**P**	C
THEORY						
MPE201	PC	Analysis of Power Inverters	3	0	0	3
MPE202	PC	Solid State AC Drive	3	0	0	3
MPE203	PC	Solid State DC Drive	3	0	0	3
MPE204	PC	Special Electrical Machines & Controllers	3	0	0	3
MPE205	PC	Power Electronics For Renewable Energy Systems	3	0	0	3
MPE2E1	PE	Professional Elective – I	3	0	0	3

PRACTICAL						
MPE2L1	PC	Power Electronics and Drives Laboratory	0	0	4	2
Total Number of Contact Hours =22Total Number of Credits= 20						

SEMESTER – III						
Course Code	**Category**	**Course Title**	**L**	**T**	**P**	**C**
THEORY						
MPE3E1	PE	Professional Elective – II	3	0	0	3
MPE3E2	PE	Professional Elective – III	3	0	0	3
MPE3E3	OE	Open Elective – I	3	0	0	3
PRACTICAL						
MPE3P1	PR	Project Work Phase – I	0	0	12	6
MPE3S1	**PR**	Seminar	0	0	2	1
MPS3V1	**PR**	Internship/Industrial Training(During summer vacation)	0	0	2	1
Total Number of Contact Hours = 25 Total Number of Credits= 17						

SEMESTER – IV						
Course Code	**Category**	**Course Title**	**L**	**T**	**P**	**C**
PRACTICAL						
MPS4P1	PR	Project Work Phase – I	0	0	24	12
Total Number of Contact Hours = 24Total Number of Credits=12						

Total No. Of Credits – 68

LIST OF ELECTIVES

S.No	Sub code	Subject Name	L	T	P	C
PROFESSIONAL ELECTIVE (PE) – I						
1.	MPE001	Wind Energy Conversion Systems	3	0	0	3
2.	MPE002	HVDC Transmission	3	0	0	3
3.	MPE003	Design Of Intelligent Controllers	3	0	0	3
4.	MPE004	Microprocessors& Microcontrollers Applications In Power Electronics	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – II						
1.	MPE005	Power Quality	3	0	0	3
2.	MPE006	Flexible AC Transmission Systems	3	0	0	3
3.	MPE007	MEMS Technology	3	0	0	3
4.	MPE008	Neural Network And Fuzzy Logic Control	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – III						
1.	MPE009	Industrial Applications Of Electrical Drives	3	0	0	3
2.	MPE010	SCADA System and Applications Management	3	0	0	3
3.	MPE011	Smart Grid	3	0	0	3
4.	MPE012	SMPS And UPS	3	0	0	3
OPEN ELECTIVE (OE)						
1.	MPE013	Solar And Energy Storage Systems	3	0	0	3
2.	MPE014	Computer Network Engineering	3	0	0	3
3.	MPE015	Digital Signal Processing	3	0	0	3
4.	MST070	Research Methodology	3	0	0	3

SEMESTER – I

MMA111	APPLIED MATHEMATICS	L	T	P	C
	Total Contact Hours: 60	3	1	0	4
	Prerequisite:				
	Course Designed by : Dept. of Mathematics				

OBJECTIVES

To apply all taught techniques to unseen problems, and present basic concepts of matrices and ma algebra, linear transformation, vector spaces,Random variable compute and interpret me correlation/covariance ,calculus is major branch of optimization deals with extreme values in cer function spaces.

COURSE OUTCOMES (COs)

CO1	Learn to manipulate matrices and to do matrix algebra, determinants, Eigen values Eigen vectors and to solve the system of linear equations
CO2	Learn to analyze and solve the fundamental problems with prescribed or free boundary conditions in simple cases.
CO3	Learn to understand how signals, systems, inference combine in prototypical tasks of communication, control and signal processing.
CO4	Apply concepts of Probability to solve problems in Electronic Engineering
CO5	Find functional relationship between random inputs and outputs with the use of Random Process Techniques. Find the linearity in Birth and Death Processes with the use of Poisson processes.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	H	H	L	M	
	CO2		H	L		
	CO3			H		M
	CO4	M	H			L
	CO5		H	H	M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

4	Approval	37th, 38th& 39thMeeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I ADVANCED MATRIX THEORY 9+3

Eigen values using QR transformations generalized eigenvectors – canonical forms, singular valued composition and application – matrix norms and induced norms pseudo inverse – least square approximations.

UNIT II CALCULUS OF VARIATIONS 9+3

Variation and its properties – Euler's Equation – Functional dependent on first and higher order derivatives – functional dependent on functions of several independent variables – constraints in the form of a functional isoperimetric problems – Direct method – Ritz and Kantorovich methods – Boundary value problems.

UNIT III SPECIAL FUNCTIONS 9+3

Series solutions – Bessel's equations – Bessel functions – Recurrence relations generating functions and orthogonal of Bessel's functions of the first kind Legendary's equations, Legendary polynomials – Rodriguez's formula applications to boundary value problems

UNIT IV PROBABILITY 9+3

Probability concepts – Random variables Discrete and continuous dissimulations – Correlations – partial, multiple, rank analysis of variance one way, two way process.

UNIT V RANDOM PROCESS 9+3

Poisson process Gaussian process Markov process-Anti Correlations-Cross correlations – Queuing models – quality control – control charts – tolerance limits.

Total No. of Periods: 60

References:

1. Sankar Rao K: "Introduction to Partial Differential Equations" – Prentice Hall of India, New Delhi 1995.
2. Elsgoth, "Differential Equations and Calculus of Variations" MIR Publishers, Moscow.
3. Grewal B.S. "Higher Engineering Mathematics, Khanna Publications, New Delhi 1989.
4. Androws L.A. "Special Function of Scientist and Engineers"
5. Venkataramn M.K. "higher engineering mathematics, the National Publishing Company, 1990.
6. Narayanan S. Manicasachagam Pillai and Ramaniah G. "Advanced Mathematics for Engineering Students" Vol II and ill, Viswanathan printers Pvt. Ltd., Madras1 1985.
7. Freund J.D. and Miller JR "Probability Statistics for Engineers" Prentice Hall of India, 5th Edition, New Delhi 1994.
8. Gupta and Kapoor V.K. "Fundamentals of Mathematics Statistics" Sultan Chand & Sons, New Delhi.

	ADVANCED CONTROL THEORY	**L**	**T**	**P**	**C**

MIC105	Total Contact Hours:45	3	0	0	3
	Prerequisite: Control system				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES

To study the analysis of systems using state space model
To understand the concept of stability
To familiarize the optimal control problem

COURSE OUTCOMES (COs)

CO1	Apply the knowledge of basic and advance control system for design of control systems.
CO2	Understand and able to apply the concepts of state variable analysis for real time applications.
CO3	To apply advanced control theory to practical engineering problems.
CO4	To understand and apply nonlinear systems for real time applications.
CO5	Analyze the concept of stability of nonlinear systems.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	H		H		M
	CO2		H			
	CO3			M		H
	CO4		H			
	CO5	H			H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

PROPERTIES OF TRANSFER FUNCTION

Impulse response matrices- poles & zeros of transfer function matrices critical frequencies resonance-steady state and dynamic response bandwith-singular value, Analysis-multivariable Nyquist plots.

UNIT II **8**

REVIEW OF STATE MODEL FOR SYSTEMS

State transition matrix & its properties-free and forced response control ability and observability-kalman's Decomposition-Minimal realization.

UNIT III **10**

STATE FEEDBACK AND STATE ESTIMATORS

Single variable case-connection of state feedback and state estimators Compensation design-design concepts-realization of basic compensation-cascade compensation in time domain and frequency domain .

UNIT IV **11**

TYPES OF NON-LINEARITY

Typical examples-phase plane analysis-isoclines method-limit cycles Equation Linearization-Describing function-Describing function analysis of simple non linear systems.

UNIT V **9**

STABILITY CONCEPTS

Equilibrium points-BIBO & Asymptotic stability-direct method of liapnov-variable gradient method of generating liapnov functions-applications to non-linear problems-krasakovskils theorem on global asymptotic stability of non linear systems.

Total No. of Periods: 45

Text Books:

1. Gopal M. Modern control system theory, New age International pvt Ltd, 2002.

References:

1. Nagrath & Gopal, Control system engineering, Wiley & Sons, 1982.
2.Ogata K. 11, Modern control engineering, PHI, 1982.
3.Ogata K.H, State space analysis of control systems, PHI.
4.Tou.J.T. Modern control theory, McGraw hill.

MPE101	ANALYSES OF POWER CONVERTERS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES

To understand and acquire knowledge about various power converter circuits and to prepare the students to analyze and design different power converter circuits.

COURSE OUTCOMES (COs)

CO1	Ability to analyze various single phase and three phase ac to dc converters power converter circuits and understand their applications.
CO2	Identify basic requirements for power electronics dc to dc converters
CO3	Analyze the operation of various AC Voltage controllers
CO4	Understand the use of power converters in commercial and industrial applications.
CO5	Use power electronic simulation packages for analyzing and designing power converters

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1		L	H		
	CO2	M				L
	CO3		M			
	CO4	H			H	
	CO5			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

AC TO DC CONVERTERS 9

Single phase and three phase bridge rectifiers half controlled and fully controlled converts with RL, RLE loads, freewheeling diodes. Dual converter, sequence control of converters. Inverter operation, input harmonics output ripple, smoothing inductance-power factor-effects of source inductance, overlap, inverter limit. Microprocessor based triggering for converters.

UNIT II

DC TO DC CONVERTERS 9

Principle of operation, choice of commutation circuit elements, step down and stem up choppers, classification, voltage and current commutated choppers, effect of source inductance, filter circuits, multiphase-chopper, resonant converter triggering circuit

UNIT III

AC PHASE CONVERTER 9

Principle of phase control, single phase bi-directional controllers with R,L. and R-L loads 3-phase controllers, different configurations. Analysis with pure R and L loads.

UNIT IV

AC TO AC CONVERTERS 9

Principle of operation, single phase and three phase cycloconverters power circuit microprocessor based triggering circuit-harmonics –power factor.

UNIT – V

APPLICATION OF CONVERTERS 9

Converter and choppers dc drives AC voltage controller for lighting and speed control of fans, cycloconverter fed A/c drives.

TEXT BOOKS:

1. Rashid M.H. ’’Power Electronics circuit devices and Applications’’, Prentice Hall India, New Delhi, 1995

2. Mohan N. Undeland and Robbins, ‘’Power Electronics- Converters, Application and Design ‘’ john Wiley and Sons. Inc., Netyork, 1995.

REFERENCES:

1. P.C. Sen, ‘’Modern power Electronics’’ wheeler publishing Co., first Edition, New Delhi-1998.

MPE102	ADVANCED SEMI CONDUCTOR DEVICES	L	T	P	C

	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Electrical and Electronics Engineering				

OBJECTIVES

To introduce students to the physics of semiconductors and the inner working of semiconductor devices and to provide students the insight useful for understanding new semiconductor devices and technologies.

COURSE OUTCOMES (COs)

CO1	Study and analyze the switching devices and their performance.
CO2	Understand and analyze the inner working of semiconductor p-n diodes, Schottky barrier diodes and new semiconductor devices
CO3	Understand the details of operation of the advanced semiconductor electronic devices
CO4	Understand operation principles and physics of IGBT and Power MOSFETs
CO5	Design and analyze semiconductor devices for different applications.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1		L		L	H
	CO2	H	L	H		H
	CO3	H	H	H	M	
	CO4	M	H	L	M	L
	CO5	L	M			M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
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UNIT I OVERVIEW OF POWER SEMICONDUCTOR SWITCHES 9

Introduction: Diodes, Thyristors, BJTs, MOSFETs, GTOs, IGBTs.- comparison of these a switching devices.

UNIT II POWER DIODES AND BJTs 9

V-I characteristics of power diodes –Scottky diode –Snubber design-switching characteristics of BJTs-Drive circuits for BJTs-safe operating area.

UNIT III Thyristors and GTOS 9

Physics of device operation and GTO's characteristics of thyristors and GTOs Ratings of Thyristors-Turn-on and Turn off mechanism of Thyristors –Protection circuits for thyristors and GTO's.

UNIT IV IGBTS and POWER MOSFETs 9

Device operation of Power MOSFET sand IGBT'S – V-I characteristics Switching characteristics of Power MOSFET S and IGBTs-Safe operating Area curve of power MOSFETS and IGBTS protection circuits for IGBTs.

UNIT V APPLICATIONS 9

Thyristor applications in Switched Mode power supplies UPS, Zero Voltage Switch, Integral Cycle and Arc welding.

Total periods: 45

REFERENCE BOOKS:

1. Kassakian J.G. et.at,-"Principles of power Electronics"- Addison Wesley
2. Murphy J. MD and Turbul G,- "Power Electronics control of AC Motors"- Pargamon Press oxford 1998.
3. Rashid M.H. Power Electronics circuits, Devices and Applications Prentice Hall India New Delhi 1995.

MPE103	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Electrical and Electronics Engineering				

OBJECTIVES

To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.

COURSE OUTCOMES (COs)

CO1	Understand the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
CO2	Analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
CO3	Analyze theory of transformation of three phase variables to two phase variables.
CO4	Analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
CO5	Analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H				
	CO2				H	
	CO3	H		H		
	CO4		H	H	H	H
	CO5	H				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNITI
PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9

Magnetic circuits, permanent magnet, stored magnetic energy, co-energy - force and torque in singly and doubly excited systems – machine windings and air gap mmf - winding inductances and voltage equations.

UNIT II
DC MACHINES 9

Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – Time domain blockdiagrams - solution of dynamic characteristic by Laplace transformation – digital computersimulation of permanent magnet and shunt d.c. machines.

UNIT III
REFERENCE FRAME THEORY 9

Historical background – phase transformation and commutator transformation – transformation ofvariables from stationary to arbitrary reference frame - variables observed from several frames ofreference.

UNIT IV
INDUCTION MACHINES 9

Three phase induction machine, equivalent circuit and analysis of steady state operation – freeacceleration characteristics – voltage and torque equations in machine variables and arbitraryreference frame variables – analysis of dynamic performance for load torque variations – digital
computer simulation.

UNIT V
SYNCHRONOUS MACHINES 9

Three phase synchronous machine and analysis of steady state operation - voltage and torqueequations in machine variables and rotor reference frame variables (Park’s equations) – analysisof dynamic performance for load torque variations – digital computer simulation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley, Second Edition, 2010.

REFERENCES

1. P S Bimbhra, “Generalized Theory of Electrical Machines”, Khanna Publishers, 2008.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, “ Electric Machinery”, Tata McGraw Hill, 5th Edition, 1992.

MPE104	SYSTEM DESIGN USING MICRO-CONTROLLERS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES

Describe the basic architecture and addressing modes of a stored-program computer. Apply the principles of top down design to microcontroller software development

COURSE OUTCOMES (COs)	
CO1	Understands types of computers & microcontrollers,
CO2	Understands 8-Bit, 16- Bit & 32 Bit advanced Microcontrollers.
CO3	Understands Real Time Applications of Microcontrollers.
CO4	Understands RTOS for Microcontrollers.
CO5	Design Hardware applications using Microcontrollers

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	H			M	
	CO2	L	M			
	CO3			H		
	CO4	M				H
	CO5				L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I

MICRO CONTROLLER RESOURCES 9

Role of micro – controllers – CPU register structure – addressing modes – family members – applications.

UNIT II

OVERVIEW OF 8051 9

Architectures of 8051 – Timers/counters – serial Interlace – Registers – Memory – Memory organization – input ports – o/p parts I/O H/W structures – Interrupts.

UNIT III

OVERVIEW OF M68HC 9

Configuring 68HCII – Intempts timers – Parallel I/o serial peripheral interface – A/O converters – wairs/stop modes

UNIT IV

INTEL 8096 STRUCTURE 9

Features of 8096 – Architecture of 8096-CPU section – I/o section – High Speed inputs – High speed o/p Interrupts – Timers Interrupt density Interval constraints I/o control status registers – reset circuitry – Ports.

UNIT V

SOFTWARE BUILDING BLOCKS / EXPANSION METHODS 9

Memory expansion methods real time control-PWN control-queues –tables – instruction set-programming

Total Periods: 45

REFERENCES

1. John B. Peatman, ‘’Design with Micro-controller’’, Mc-Graw Hill International.

2. John C. Roder ‘’Using the M68HC11 Micro – controller

SEMESTER II

MPE201	**ANALYSIS OF POWER INVERTERS**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES To understand and acquire knowledge about various power semiconductor devices.

COURSE OUTCOMES (COs)

CO1	Analyze various single phase and three phase power inverters circuits and understand their applications.
CO2	Identify basic requirements for Series inverters based design application.
CO3	Develop skills to build, and troubleshoot Current source bridge inverter circuits.
CO4	Understand the use of modern inverters, SMPS and UPS
CO5	Understand the use of power converters in commercial and industrial applications.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1		H	L		
	CO2	H				H
	CO3		M			
	CO4		L	L		
	CO5				M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I

INVERTERS **9**

Single Phase and three phase voltage source and current source inverters need for feed back diodes in anti parallel with switches-configuration single phase voltage source inverter. Half and full bridge selection of switching frequency and switching device.

UNIT II

SCR BASED INVERTER **9**

Series inverters: basic series inverter, modified series inverter, high frequency series inverter, three phase series inverter – design parallel inverter, single phase accxilliary commutated inverter: Mc Murray Bedford inverter.

UNIT III

SCR BASED INVERTER **9**

Current source bridge inverter, analysis of single phase and three – phases auto sequential commutated current source inverter.

UNIT IV

MODERN INVERTERS **10**

BJT/IGBT based modern high switching inverters, Need for output voltage control and Harmonics elimination, PWM inverters: principle of SMPS and UPS, resonant inverter: ZCS&ZVC concepts.

UNIT V

APPLICATION OF INVERTERS **8**

VSI and CSI fed 3 – Phase induction motor drives

Total Periods: 45

TEXT BOOK:

1. G.K. Dubey Eta, "Thyristoised Power Controllers" New Age International Pvt., Ltd. New Delhi, 1996.

REFERENCE BOOKS:

1. Rashid MH, "Power Electronics Circuits Devices and Applications" Prentice Hall India Second Edition, New Delhi 1995

2. P.S. Bimbhra, “Power Electronics,” Khanna Publications New Delhi 1996.

MPE202	**SOLID STATE AC DRIVE**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVESUnderstand the stable steady state operation and transient dynamics of motor-load system

COURSE OUTCOMES (COs)	
CO1	Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory
CO2	Apply the concepts of power electronics into real time problems.
CO3	Application of drives to electrical engineering problems.
CO4	Ability to understand the stable steady state operation and transient dynamics of motor-load system
CO5	Learn characteristics and control of solid state AC motors drives.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1		L			
	CO2	H				
	CO3				H	L
	CO4		H			
	CO5	L				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th& 39thMeeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

STATOR VOLTAGE CONTROL OF INDUCTION MOTOR 9

Torque, slip characteristics, operation with different types of loads, performance comparison of different AC power controllers speed reversal, closed loop control

UNIT II

STATOR FREQUENCY CONTROL 9

Operation of induction motor Non-Sinusoidal supply waveforms, Variable frequency, operation of 3 phase induction motor, constant flux operation, current fed operation dynamic and regenerative braking of CSI and VSI fed drives.

UNIT III

ROTOR RESISTANCE CONTROL 9

Torque, slip characteristics, types of rotor choppers, torque equation, constant torque operation, TRC strategy, combined stator voltage control and rotor resistance control

UNIT IV

SLIP POWER RECOVERY SCHEME 9

Torque equation, torque – slip characteristics-power factor consideration, Sub-Synchronous operation closed loop control.

UNIT V

SYNCHRONOUS MOTOR DRIVES 9

Need for leading pf operation –open loop VSI fed and its characteristics –self control torque angle control –power factor control- Brushless excitation systems staring, principles of vector control

Total Periods: 45

REFERENCES:

1. Dubey, G.K. ‘’Power Semiconductor controlled drives’’, Prentice Hall international, New Jersey,1989

2. Dewan, S.B. Slemon, G.R. Straughen, ‘’A Power Semiconductor Drives’’ John Wiley and Sons New York, 1984

MPE203	SOLID STATE DC DRIVE	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES

Understand the stable steady state operation and transient dynamics of motor-load system

COURSE OUTCOMES (COs)

CO1	Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory
CO2	Application of drives to electrical engineering problems.
CO3	Apply the concepts of power electronics into real time problems
CO4	Learn characteristics and control of solid state DC motors drives.
CO5	Learn digital control DC drives

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1				L	
	CO2	H		H		
	CO3		M			
	CO4					L
	CO5	L			H	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th& 39thMeeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

REVIEW OF CONVENTIONAL DC DRIVES 12

Different technique of speed control and method of braking of series and separately excited motor, ward-Leonard speed control, models and transfer function of series and separately excited dc motor.

UNIT II

CONVERTER CONTROL OF DC MOTOR 12

Analysis of series and separately excited DC motor with three phase and single phase converter operating in different modes and configurations. Problems on converter fed dc machine. CLC and TRC strategies.

UNIT III

CHOPPER CONTROL OF DC MOTORS 12

Analysis of series and separately excited de motor fed from different choppers, effect of saturation in series motor, CLC and TRC strategies, Microprocessor based firing circuit.

UNIT IV

DESIGN OF CONVERTER FED DC DRIVES 12

Speed loop, current loop, armature current reversal, digital controller and microprocessor based firing circuits, simulation.

UNIT V

INTELLIGENT CONTROLLER FOR DRIVES 12

Microcomputer implementation of control function fuzzy, neuro, fuzzy-neuro controllers.

Total Periods: 60

TEXT BOOKS:

1. Dubey, G.K. ‘’Power Semiconductor controlled drives’’, Prentice Hall international, New Jersey,1989

2. SEN. P. C. ‘’Thyristor DC Drives’’, John Wiley Sons, Newyork, 1981.

REFERENCES:

1. SUBHRAMANYYAM. V. ‘’Electric Drives – Concepts and Applications’’, Tata-McGraw Hill, Publishing Co., Ltd. New Delhi, 1994.

2. B. K. Bose. ‘’Expert System, Fuzzy logic and Neural Network application in power Electronics and Motion Control’’, Proceeding of the IEEE Special issue on power electronics and motion control, August- 1994, PP-1303.

MPE204	**SPECIAL ELECTRICAL MACHINES AND CONTROLLERS**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES To learn about the construction and working principle of special electrical machines

COURSE OUTCOMES (COs)	
CO1	The ability to understand axial and radial air gap of Synchronous Reluctance Motors
CO2	The ability to understand open loop control, closed loop control of stepping motor.
CO3	The ability to understand microprocessor based controller of Switched Reluctance Motor
CO4	The ability to understand EMF equation, Torque – Speed characteristics Controllers Of Permanent Magnet Brushless Dc Motors
CO5	The ability to understand EMF equation, Torque – Speed characteristics Controllers of Permanent Magnet Synchronous Motors

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1					
	CO2	M		M	L	
	CO3					M
	CO4		L			
	CO5			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features-types-axial and radial air gap motors-operating principle-reluctant torque-phasor diagram-characteristics-Vernier motor.

UNIT II

STEPPING MOTORS 11

Constructional features of operation, modes of excitation torque production invariable Reluctance (VR) stepping, motor, Dynamic Characteristics, Drives systems and circuits for open loop control, closed loop control of stepping motor.

UNIT III

SWITCHED RELUCTANCE MOTOR 11

Constructional features, principle of operation, torque equation, power controller's characteristics and controllers, characteristics and control microprocessor based controller.

UNIT IV

PERMANENT MAGNET BRUSHLESS DC MOTORS 12

Communication in DC motors, difference between mechanical and electronics communications, Hall sensors, optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives and emf equation, Torque – Speed characteristics Controllers – Microprocessors based controller.

UNIT V

PERMANENT MAGNET SYNCHRONOUS MOTORS 11

Principle of operation, EMF, power input and torque expressions, Phasor diagram power controllers, Torque – speed characteristics, self control Vector Control, Current control schemes.

Total Periods: 45

REFERENCES:

1. Brush Permanent Magnet and Reluctance Motor Drives – Miller T.J.E. Clarendon Press, Oxford, 1989.

2. Permanent magnet and Brushless DC motors, kenjo T. and Naganori S. Clarendon Press, Oxford, 1989.

3. Stepping Motors and their Microprocessor Control – Kenjo T. Clarendon Press, Oxford, 1989.

MPE205	POWER ELECTRONICS FOR RENEWABLE ENERG SYSTEMS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by :				

OBJECTIVES	To learn about the impacts of renewable energy generation on environment
COURSE OUTCOMES (COs)	
CO1	The ability to understand different renewable energy resources : Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems
CO2	The ability to understand fundamentals of IG, PMSG, SCIG and DFIG.
CO3	The ability to understand Principle of Operation of solar and wind power systems
CO4	The ability to understand Grid Connection Issues
CO5	The ability to understand Hybrid Systems- Case studies

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1					M
	CO2	M	H	L		
	CO3					
	CO4	H	M		M	
	CO5					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I **9**

INTRODUCTION

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost- GHG Emission) – Qualitative study of different renewable energy resources : Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II **9**

ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION

Review of reference theory fundamentals – Principle of Operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT-III **9**

POWER CONVERTERS

Solar: Block diagram of solar photo voltaic system – Principle of Operation: Line Commutated Converters (inversion – mode) –Boost and Buck- Boost Converters- Selection of Inverter, battery sizing, array sizing.

Wind: Three phase AC Voltage Controllers- AC-DC-AC Converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters- Matrix Converters.

UNIT-IV **9**

ANALYSIS OF WIND AND PV SYSTEMS

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid Connection Issues- Grid integrated PMSG and SCIG Based WECS- Grid integrated solar System.

UNIT-V **9**

HYBRID RENEWABLE ENERGY SYSTEMS

Need for Hybrid Systems- Range and type of Hybrid Systems- Case studies of Wind- PV- Maximum Power point Tracking(MPPT).

Total Periods: 45

REFERENCES:

1. Rashid.M.H.”Power Electronics Hand book”, Academic press,2001.
2. Rai.G.D.”Non conventional energy sources”, Khanna Publishers,1993.
3. Rai.G.D.”Solar energy Utilization “Khanna Publishers,1993.
4. Gray.L..Johnson. ”Wind Energy System”. Prentice Hall linc,1995.
5. Non-Conventional Energy Sources B.H.Khan Tata McGraw-hill Publishing company, New Delhi.

ELECTIVES

PROGRAMME ELECTIVE (CE) – I

MPE001	**WIND ENERGY CONVERSION SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Electrical Machines, Power system				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES

To understand and analyze the present and future energy demand of world and nation.

Techniques to exploit the available renewable energy resources such as, wind power effectively.

COURSE OUTCOMES (COs)

CO1	To understand and analyse the basic schemes and components of wind energy conversion system.
CO2	To understand and analyse the design concepts of wind turbines
CO3	To understand the concepts of fixed speed wind energy conversion systems
CO4	To understand the concepts of variable speed, wind energy conversion systems
CO5	To analyze the grid integration issues.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	M	M	L	M	L
	CO2	H	M	L	H	L
	CO3	M	M	L	M	L
	CO4	M	H	L	M	L
	CO5	H	M	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNITI
INTRODUCTION TO WECS 9
Components of WECS-Schemes of WECS-Power obtained from wind- simple momentum theory-power coefficient- Sabinin's theory- Aerodynamic s of wind turbine.

UNIT-II
WIND TURBINES 9
HAWT-VAWT-Power developed –Thrust – Efficiency- Rotor selection – Rotor design considerations- Tip Speed ratio- No of Blades- Blade profile-Power Regulation-Yaw control- Pitch angle control-stall control- Schemes for maximum power extraction.

UNIT-III 9
FIXED SPEED SYSTEMS
Generating Systems- Constant speed constant frequency systems- Choice of Generators- Deciding factors- synchronous Generator- squirrel cage induction Generator- Model Wind turbine rotor-Drive Train Model- Generator model for steady state and Transient Stability analysis.

UNIT-IV 9
VARIABLE SPEED SYSTEMS
Need of variable speed systems- Power-Wind speed Characteristics –Variable speed constant frequency systems synchronous generator- DFIG-PMSG-Variable speed generators modeling-Variable speed variable frequency schemes.

UNIT-V 9
GRID CONNECTED SYSTEMS
Stand alone and Grid connected WECS system – Grid connection Issues- Machine side & Grid Side controllers- WECS in various countries.

Total Periods: 45

TEXT BOOKS:

1. L.L.Freris "Wind Energy Conversion Systems", Prentice Hall,1990.
2. Ion Boldea, "Variable Speed Generators", Taylor & Francis group,2006.

REFERENCE

1. E.W.Golding "The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
2. S.Heir "Grid Integration of WECS", Wiley 1998.
3. L.L.Freris "Wind Energy Conversion Systems", Prentice Hall,1990.
4. Ion Boldea, "Variable Speed Generators", Taylor & Francis group,2006.
5. E.W.Golding "The Generation of Electricity by Wind Power:, Redwood burn Ltd., Trowbridge, 1976.
5. S.Heir "Grid Integration of WECS", Wiley 1998.

MPE002	HIGH VOLTAGE DC TRANSMISSION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Power Electronics, High Voltage Engineering.				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES

To mould the students to acquire knowledge about HVDC Transmission systems

COURSE OUTCOMES (COs)

CO1	To get an idea about modern trends in HVDC Transmission and its application
CO2	To complete analysis of harmonics and basis of protection for HVDC Systems.
CO3	To understand the power flow control on HVDC Transmission system
CO4	To Understand the Operation of the controller for HVDC in worst and normal operations
CO5	To understand the complete operation of HVDC Converter stations

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1					H
	CO2	H	H	H	M	M
	CO3	H	M	M	M	
	CO4	H	M		M	
	CO5		M		M	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INRODUCTION 9

Comparison of AC and DC transmission-Types of DC links-components of HVDC systems principal application of DC transmission-merits and demerit of DC transmission-modern trends in DC transmission

UNIT II THYRISTOR CONVERTORS AND ANALYSIS 9

Thyristors-switching and steady state characteristics-valve firing-recent trends-pulse number converter configuration-analysis of Gratez circuit-converter bridge characteristics pulse converter.

UNIT III HVDC SYSTEM CONTROL 9

Desired features of control-converter control characteristics-constant current control extinction angle control-system control-firing angle control Reactive power control

UNIT IV STABILITY ANALYSIS 9

Modeling of converter-DC network and synchronous generator-solution methodology-transient stability improvement using DC link control voltage stability in AC-DC systems control.

UNIT V POWER MODULATION AND HARMONICS 9

Power modulation controls, reactive power modulation. Characteristic harmonics-troubles due to harmonics-harmonic filters.

Total Periods:45

REFERENCES:

1. HVDC Power transmission system-Padiyar K.R. wiley Eastern Pvt. Ltd. 1980.
2. Direct current Transmission-Kimbark, Vol 1., John Wiley, New York, 1971.
3. Computer Modeling of electric Power Systems-Arriliaga J. and Arnald C.P. & Parker B.J., John wiley& Sons, 1983.

MPE003	**DESIGN OF INTELLIGENT CONTROLLERS**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Neural Network and Fuzzy Logic				
	Course Designed by : Department of Electrical and Electronics Engineering				

OBJECTIVES:

To master the complete idea of design of Intelligent Controllers by learning planning strategies, Reliability analysis and distribution protection.

COURSE OUTCOMES (COs)

CO1	To learn the structure , operation and design of Intelligent Controllers
CO2	To learn the planning strategies in the design of Intelligent Controllers
CO3	To have a clear understanding of reliability analysis.
CO4	To learn the voltage control and its advancements in distribution
CO5	To learn the protection of feeders.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H		H		M
	CO2	L	M		H	L
	CO3	L	M	M	H	
	CO4		H		H	H
	CO5	L		L		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I INTRODUCTION 9

Model based controllers – adaptive controllers – model reference adaptive control –model identification adaptive controllers – optimal control – predictive control

UNIT II ARTIFICIAL INTELLIGENT BASED CONTROLLERS 9

Natural language system – perception system for vision speech and touch – export or knowledge-representation – inference strategy – expert controller

UNIT III FUZZY LOGIC SYSTEM 9

Introduction – fuzzy controller - fuzzyfier – knowledge base- defuzzyfier- fuzzy logic tools – fuzzy logic controller

UNIT IV ARTIFICIAL NEURAL NETWORK 9

Introduction – Artificial Network –Classification Based on Topology and Learning Method – Learning Rules Perception – Multi I/P and multi O/P perception -multi layer artificial neural network – error propagation learning algorithm – neural controllers.

UNIT V APPLICATION OF FLC AND NEURAL NETWORKS 9

Non – Linear fuzzy control – PID – with FLC – sliding mode FLC – adaptive – fuzzy control application – Case studies

Total periods: 45

TEXT BOOKS:

1. Hetz, John Krogh, Andrsand Palmer, Richard, G. “Introduction to theory of neural computation”- Addison – Wesley New York 1991.

2. King. P.J. and Momdoni E.H, “The Applications of fuzzy control systems to industrial processes”- 6th IFAC congress on control technology in the service of man, 1975.

REFERENCE BOOKS:

1. Nelson, Morgan, “Artifical Neural Networks: Electronic implementation”- IEEE Computer Society Press, USA1990.

<table>
<tr><td rowspan="4">MPE004</td><td>MICRO PROCESSORS & MICROCONTROLLER APPLICATION IN POWER ELECTRONICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Total Contact Hours: 45</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="5">Prerequisite:</td></tr>
<tr><td colspan="5">Course Designed by :Department of Electrical and Electronics Engineering</td></tr>
</table>

OBJECTIVES

To learn the basic architecture and addressing modes of microprocessor and microcontroller and to apply the principles to Power Electronic Applications.

COURSE OUTCOMES (COs)

CO1	Have knowledge on the types of computers, microcontrollers and microprocessors.
CO2	Interface microcontrollers through external circuit interface to a variety of sensors and actuators.
CO3	Describe different types of memory used in microcontroller systems and typical I/O interface and to discuss timing issues
CO4	Understand the architecture and use of various on-chip peripherals of microcontroller and Develop algorithms for various control system blocks for power converters.
CO5	Develop themselves in interfacing microcontrollers with power electronics drive and Selection of drives system for particular applications

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	H	H	M		H
	CO2				L	H
	CO3	H	M		L	H
	CO4	H			L	
	CO5	L	L	H	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I REVIEW OF MICROPROCESSORS AND MICRO CONTROLLER 9

Architecture and programming of 8085, 8086, 8096 A/D and D/A converters- Interfacing of 8252, 8255 and other important interfacing ICs.

UNIT II MICROPROCESSOR BASED FIRING SCHEME FOR CONVERTERS 9

Firing schemes for single phase and three phase rectifiers-3 phase AC choppers, firing at variable frequency environment, firing scheme for DC Choppers, voltage and current communication inverters, types of pulse with modulation techniques, their implementation, using Microprocessors

UNIT III MICROPROCESSORS/MICRO-CONTROLLERS IN CLOSED LOOP CONTROL SCHEMES 9

Importance of measurement and sensing in closed loop control, measure of voltage current, speed power and power factor using microprocessors / micro controllers, implementation of various types of controllers using microprocessors/micro-controllers.

UNIT IV MICROPROCESSORS/MICRO-CONTROLLERS IN SPECIAL APPLICATION OF POWER ELECTRONICS 9

Static excitation of synchronous generators, solid state tap-changers for transformers UPS systems, induction motors.

UNIT V APPLICATION OF MICROPROCESSOR 9

Firing scheme to the control of DC driven induction motor, synchronous motor and stepper motor.

Total periods: 45

TEXT BOOKS:

1. Gaonkar. RS-"Microprocessor Architecture, Programming and Application with 8080/8085 Wiley Easter Limited"- New Delhi 1991

REFERENCE BOOKS:

1. Hall D.V- "Microprocessors and interfacing McGraw Hill publishing company"- New Delhi 1986
2. John B. Peatman-"Design with microcontrollers"- McGraw Hill international Singapore 1989

PROFESSIONAL ELECTIVE (CE) – II

		L	T	P	C
MPE005	**POWER QUALITY**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite:				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES

Understandthevariouspower quality phenomen theiroriginandmonitoringandmitigationmethods.Understandtheeffectsofvarious powerqualityphenomenoninvarious equipment.

COURSE OUTCOMES (COs)

CO1	Able to know the severity of power quality problems in distribution system
CO2	Able to understand the analysis of single phase and three phase system
CO3	Able to Conventional load compensation methods
CO4	Able to understand the concepts of load compensation.
CO5	Understanding the basics of FACTS devices.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1			M	H	
	CO2	H				
	CO3					H
	CO4	H			H	
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION **9**

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT II

ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM **9**

Single phase linear and non linear loads – single phase sinusoidal, non sinusoidal source – supplying linear and nonlinear load – three phase Balance system – three phase unbalanced system – three phase unbalanced and distorted source supplying non linear loads – concept of pf – three phase three wire – three phase four wire system.

UNIT III

CONVENTIONAL LOAD COMPENSATION METHODS **9**

Principle of load compensation and voltage regulation – classical load balancing problem: open loop balancing – closed loop balancing, current balancing – harmonic reduction and voltage sag reduction – analysis of unbalance – instantaneous of real and reactive powers – Extraction of fundamental sequence component from measured.

UNIT IV

LOAD COMPENSATION USING DSTATCOM **9**

Compensating single – phase loads – Ideal three phase shunt compensator structure – generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode

UNIT V

SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM **9**

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

Total No of periods: 45

REFERENCE BOOKS:

1. Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
2. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994(2nd edition)
3. Power Quality - R.C. Duggan
4. Power System Harmonics –A.J. Arrillga
5. Power Electronic Converter Harmonics –Derek A. Paice.

MPE006	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by :Department of Electrical and Electronics Engineering				

OBJECTIVES

To understand the various aspects of Flexible AC Transmission Systems, the FACTS devices, their design, principle of operation and the mode of compensation

COURSE OUTCOMES (COs)

CO1	The ability to understand the working principle of various devices like Resonance damper, Thyristor controlled series capacitor, static condenser and phase angle regulator.
CO2	The ability to understand the modelling and control of thyristor controlled series Compensators.
CO3	The ability to understand how to control and Implementation of power flow control using conventional thyristor.
CO4	The ability to understand Implementation of power flow control using conventional Thyristor.
CO5	The ability to understand various types of compensation devices.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H		H		H
	CO2	H	H		M	H
	CO3		H		M	
	CO4	M	M	L		H
	CO5	H	L	L	H	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	37^{th} , 38^{th}& 39^{th} Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INTRODUCTION 9

FACTS-A toolkit, basic concepts of static VAR compensator, Resonance damper, Thyristor controlled series capacitor, static condenser, phase angel regulator, and other controllers.

UNIT II SERIES COMPENSATION SCHEMES 9

Sub-synchronous resonance, torsional interaction, torsional torque, compensation of conventional, ASC NHG damping schemes, modelling and control of thyristor controlled series compensators.

UNIT III UNIFIED OWER FLOW CONTROLLERS 9

Introduction, Implementation of power flow control using conventional thyristor, unified power flow concept, implementation of unfiled power flow controller.

UNIT IV DESIGN OF FACTS CONTROLLERS 9

Approximate multi-model decomposition, variable structures FACTS controllers for power system transient stability, Non-linear variable-structure control, variable-structures series capacitor control, variable-structure resistor control.

UNIT V STATIC VAR COMPENSATION 9

Basic concepts, Thyristor controlled reactor (TCR)- Thyristor switched reactor(TSR)- Thyristor switched capacitor(TSC)- Saturated Reactor (SR) and Fixed Capacitor (FC)

Total Periods: 45

References:

1.Narin G.Hingorani-“Flexible AC Transmission”-IEEE Spectrum April 1993, pp40-45.

2. Narin G.Hingorani-“High Power electronics and Flexible AC Transmission Systems”-IEEE power Engineering Review, 1998.

3. Narin G. Hingorani-“Power Electronics in Electric Utilities Role of power electronics in future power systems”-Proceedings of IEEE, Vol 76 No.4 April 1998.

4. Einar V. Larsen, Juan J. Sanchez-Gasca, Joe H. Chow, “Concepts for design of FACTS k controllers to damp power swing” , IEEE Trans on power systems, Vol 10 No2 May 1995

5. Gyugyi L “Unified power flow controller concepts for Flexible AC transmission”-IEEE procedings, Vol 139 No.4.July 1992

MPE007	MEMS TECHNOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by :Department of Electrical and Electronics Engineering				

OBJECTIVES

To understand the principle of operation, various fabrication techniques and the application areas of MEMS Devices.

COURSE OUTCOMES (COs)

CO1	Propose, plan and develop MEMS devices and applications
CO2	Understand multi domain problems: thermal, fluidic, mechanical and electrical
CO3	Design a fabrication process of a MEMS device
CO4	Extend the principles of micro fabrication to the development of micromechanical devices and the design of Microsystems
CO5	Analyze and model the behavior of micro electromechanical devices and systems.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	L	H		L	
	CO2	H		M	L	H
	CO3	H	L	M		H
	CO4	M	L	H	M	L
	CO5		M		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION TO MEMS 9

Overview of Micro fabrication – Silicon and other material based fabrication processes-Concepts: conductivity of Semiconductors – Crystal planes and orientation- Stress and Strain-Flexural beam bending analysis- torsional deflections- Intrinsic Stress- resonant frequency and quality factor

UNIT-II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and Actuators – applications.

UNIT-III THERMAL SENSING AND ACTUATION 9

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors- Applications.

UNIT-IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezoelectric effect- cantilever piezoelectric actuator model- Properties of piezoelectric materials- Applications.

UNIT-V CASE STUDIES 9

Piezoresistive sensors, Magnetic actuation, Micro fluids applications, Medical applications, Optical MEMS.

Total Periods: 45

REFERENCE BOOKS

1. Chang Liu, "Fundamentals of MEMS"-Pearson International Edition,2006.
2. Marc Madou, "Fundamentals of Micro fabrication",-CRC Press,1997.
3. Boston, "Micro machined Transducers sourcebook",-WCB McGraw Hill,1998.
4.M.H.Bao, "Micromechanical transducers: Pressure sensors, Accelerometers and Gyroscopes",-Elsevier, Newyork,2000.

		L	T	P	C
MPE008	**NEURAL NETWORKS AND FUZZY LOGIC CONTROL**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Digital Electronics, Basics of set theory				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES

- To expose the students to the concepts of fuzzy sets and operations.
- To provide adequate knowledge about feed forward and back propagation neural networks.
- To have sound knowledge about neuron models,learning algorithms and applications.

COURSE OUTCOMES (COs)

CO1	To understand and analyze the fuzzy sets and fuzzy logic.
CO2	To understand the fuzzy notations,fuzzy controllers and algorithms
CO3	To understand and analyze artificial neural network architecture and algorithms
CO4	To study about self organizing maps ,adaptive resonance theory and network architectur
CO5	To apply the fuzzy and neural network concepts in real time applications image process control system and signal processing.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	L	L	M	M	L
	CO2	M	M	M	M	L
	CO3	M	M	M	M	L
	CO4	M	M	L	M	L
	CO5	H	H	L	M	L
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT – I **9**

FUZZY SETS AND FUZZY SYSTEMS

Fuzzy sets – properties of fuzzy sets – representation of fuzzy sets – operations of fuzzy sets – fuzzy relation – relation composition. Fuzzy system– Rule based fuzzy system – linguistic model – Singleton model - Relational model – Takagi – Sugeno model – Dynamic fuzzy systems.

UNIT – II **9**

FUZZY CLUSTERING AND FUZZY CONTROL

Basic notations – hard and fuzzy partitions – fuzzy C- means clustering – Gustafson – Kessel algorithm. Knowledge based fuzzy control – Motivation for fuzzy control – fuzzy control as a parameterization of controllers non-linearities – mamadani controller – Takasi - sugeno controller – fuzzy supervisory control.

UNIT – III **9**

ARTIFICIAL NEURAL NETWORKS

Biological neuron – artificial neuron – neuron network architecture – learning – Multilayer neural network – radial based function network. Perception – multilayer perception architecture-Back propagation algorithm and its variant.

UNIT – IV **9**

NETWORK ARCHITECTURES

Hopfield network-kohonen-Self organizing maps – ART I and II, Grossberg nets recurrent network – reinforcement learning.

UNIT – V **9**

CONTROL BASED ON FUZZY AND NEURAL MODELS

Applications of fuzzy logic and neural network to measurement, control, signal processing and image processing.

Total No of Periods: 45

TEXT BOOKS:

1. Laurance Fausett, ”Fundamentals of Neural Network”, Prentice Hall, Englewood Cliffs N-S, 1992.
2. Jacek M. Zurava, Introduction to Aritificial neural system, Jiaco publishing House, Mumbai. 1997.

REFERENCE:

1. Draiankor D. Hellendron H. Reinfrank. M. An introduction to fuzzy control Narosa publishing House. New Delhi 1996.
2. Timothy J- Ross. Fuzzy logic with engineering applications. International editions.

PROFESSIONAL ELECTIVE (CE) – III

MPE009	**INDUSTRIAL APPLICATIONS OF ELECTRICAL DRIVES**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Power Electronics				
	Course Designed by :Department of Electrical and Electronics Engineering				

OBJECTIVES

To understand and examine various motor terminologies, their applications and their control procedure

COURSE OUTCOMES (COs)	
CO1	To know the functions and applications of AC drives and DC drives.
CO2	Describe the functioning of electric drives
CO3	Obtain the rating and heating of motors employed for various applications
CO4	Describe the various applications of drives
CO5	Analyze the converter based drives

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	L	H		L	
	CO2	H		M	L	H
	CO3	H	L	L		H
	CO4	M	L	L	M	L
	CO5		M		M	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I INTRODUCTION 9

Requirements of an adjustable speed drive – Forms of drive motors – AC drives versus DC drives – Trends in drive Technology

UNIT-II DYNAMICS OF ELECTRIC DRIVES 9

Introduction – Classification electric drive – Basic elements of an Electric drive – Dynamic conditions of a drive system – Stability condition of electric drive – Selection of motors – Characteristics of motors for variable speed drives.

UNIT-III RATING AND HEATING OF MOTORS 9

Requirements of a drive motor –Power losses and heating of electric motors – Heating and cooling curves of an electric power – classes of duty – selection of design ruling motor.

UNIT-IV DRIVES FOR SPECIFIC APPLICATIONS 9

Introduction - Drives and motors for textile mills – Steel rolling mills – Cranes and Hoist drives –Cement mills – Sugar mills – Machine tools – Paper mills – Coal mines – Centrifugal mills – Turbo compressors – Traction. A review of thyristorised DC and AC drives.

UNIT-V HIGH POWER INDUSTRIAL DRIVES 9

Introduction – Drive rating classification with speed and power ratings – Versatility of DC drive and Limitations at large power and high speed - Thyristorised of DC drive and Limitations at large power and induction motor drives at high power level – a short survey of the evaluation of large power drive – Synchronous motor drives – Load commutated converter motor fed from a CSI – Operating modes of motor – Converter – Motor plus converter – implementation of the system – converter for high power – cooling system – fault tolerant design – Reduction of line harmonics and improvement of line power factor – Applications.

Total Periods: 45

REFERENCE BOOKS:

1. Vedam Subrahmanyam, "Electric Drives, Concepts and Applications" , TMH, 1994
2. Richard M. Crowder, "Electric Drives and Their Controls", Clorendon, Oxford 1995

MPE010	SCADA SYSTEM AND APPLICATIONS MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Power Electronics				
	Course Designed by :Department of Electrical and Electronics Engineering				

OBJECTIVES

• To understand about the SCADA system components and SCADA communication protocols

• To provide knowledge about SCADA applications in power system

COURSE OUTCOMES (COs)

CO1	know the basic SCADA Functional requirements and Applications
CO2	Understand the SCADA system components
CO3	Describe the SCADA communication
CO4	Analyze the SCADAmonitoring and control
CO5	Analyze the SCADAapplications in power system

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H	H		H	M
	CO2		H			M
	CO3			H		
	CO4				H	
	CO5		H			H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

INTRODUCTION TO SCADA 9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II

SCADA SYSTEM COMPONENTS 9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III

SCADA COMMUNICATION 9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV

SCADA MONITORING AND CONTROL 9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V

SCADA APPLICATIONS IN POWER SYSTEM 9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
5. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999
6. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, “Engineering of Distributed Control Systems”, Nova Science Publishers, USA, 1st Edition, 2001

Total Periods: 45

MPE011	**SMART GRID**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: FACTS, Power Generation Systems, Transmission and Distributior				
	Course Designed by : Dept of Electrical & Electronics Engineering				

OBJECTIVES

• To provide students with a working knowledge of fundamentals, design, analysis, and development of Smart Grid, from the basic concepts of power systems to the inherent elements of computational intelligence, communication technology and decision support system.

COURSE OUTCOMES (COs)

CO1	able toUnderstand the fundamental element of the smart grid,
CO2	able toUnderstand the fundamental structure of the power grid
CO3	use simulation tools such as Matlab and Paladin, for power flow analysis, optimization and state estimation
CO4	understand communication, networking, and sensing technologies involved with the smart grid
CO5	Develop computational techniques involved with the smart grid (decision support tools and optimization)

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	M				
	CO2	H	H	H	H	M
	CO3	M	M		M	H
	CO4	M	M	H	M	M
	CO5	H	H	M	M	M
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient &Self Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.

UNIT II SMART GRID TECHNOLOGIES 9

Technology Drivers, Smart energy resources,Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control,Fault Detection, Isolation and service restoration, Outage management,High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits,AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Total Periods: 45 Periods

REFERENCES:

1. Vehbi C. Güngör, DilanSahin, TaskinKocak, SalihErgüt, ConcettinaBuccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies: Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
2. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang "Smart Grid – The New and
3. Improved Power Grid: A Survey" , IEEE Transaction on Smart Grids,
4. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions",CRC Press 2012.
5. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,
6. "Smart Grid: Technology and Applications", Wiley.

MPE012	SMPS AND UPS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite:				
	Course Designed by :Department of Electrical and Electronics Engineering				

OBJECTIVES

To acquire knowledge in the design, principle and operation of Switch Mode Power Supplies and Uninterrupted Power Supplies

COURSE OUTCOMES (COs)

CO1	Understand conceptual knowledge in modern power electronic converters and its applications in electric power utility
CO2	Describe switching mode power converters
CO3	Design the resonant converter
CO4	Understand the operation of DC-AC Converters
CO5	Describe the operation of power conditioners, UPS& filters

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H	H	H	M	
	CO2	L		M	H	L
	CO3	H		L		
	CO4	L	L	H	M	L
	CO5	M	M		M	H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th , 38th& 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I DC-DC CONVERTERS 9

Principles of stepdown and stepup converters – Analysis and state space modelling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II SWITCHING MODE POWER CONVERTERS 9

Analysis and state space modelling of flyback, Forward, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT III RESONANT CONVERTERS 9

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT IV DC-AC CONVERTERS 9

Single phase and three phase inverters, control using various (sine PWM, SVPWM and an advanced modulation) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT V POWER CONDITIONERS, UPS & FILTERS 9

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

Total Periods: 45

REFERENCES:

1. M.H. Rashid – "Power Electronics handbook', Elsevier Publication, 2001.
2. Kjeld Thorborg, "Power Electronics – In theory and Practice", Overseas Press, First Indian Edition 2005.
3. Philip T Krein, "Elements of Power Electronics", Oxford University Press
4. Ned Mohan, Tore.M.Undeland, William.P.Robbins, "Power Electronics converters, Applications and design"- Third Edition- John Wiley and Sons- 2006
5. M.H. Rashid – "Power Electronics circuits, devices and applications"- Third edition-Prentice Hall of India New Delhi, 2007.

OPEN ELECTIVE (OE) – I

MPE013	**SOLAR AND ENERGY STORAGE SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Basics of Renewable Energy Sources				
	Course Designed by : Dept. of Electrical & Electronics Engineering				

OBJECTIVES

To Study about solar modules and PV system design and their applications , grid connected systems and about different energy storage systems

COURSE OUTCOMES (COs)

CO1	To understand the Characteristics of sunlight and solar cells
CO2	To describe the stand alone PV system
CO3	To understand Grid connected PV systems
CO4	To know Energy storage systems
CO5	To describe the Applications of solar systems

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	H			M	H
	CO2		H			
	CO3	H		M		H
	CO4		H		H	
	CO5	H		M		H
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I
INTRODUCTION **9**

Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection.

UNIT II **9**
STAND ALONE PV SYSTEM

Solar modules – storage systems – power conditioning and regulation - protection – stand alone PV systems design – sizing.

UNIT III **9**
GRID CONNECTED PV SYSTEMS

PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs.

UNIT IV **9**
ENERGY STORAGE SYSTEMS

Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage

UNIT V **9**
APPLICATIONS

Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

Total No of Periods : 45

References:

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems, Progensa,1994.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, Applied Photovoltaics, 2007,Earthscan, UK.
3. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook , CRC Press, 2011.
4. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
5. Solar Energy – S.P. Sukhatme, Tata McGraw Hill,1987.

MPE014	COMPUTER NETWORK ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Nil				
	Course Designed by : Department of Computer Science Engineering				

OBJECTIVES

To master the concept of Computer Network Engineering and their usage in various Power Electronics applications.

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of expert systems and their applications
CO2	To learn the concepts of artificial intelligence systems and their applications
CO3	To master the programming in Computer Network Engineering
CO4	To use and analyze Computer Network concepts for Power electronics problems
CO5	To program and to trouble shoot the Computer Network based problems

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e
2	CO1	H			H	H
	CO2	H			H	L
	CO3	H	M		M	M
	CO4		H	L		H
	CO5			L		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37th, 38th & 39th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I PROTOCOLS AND ARCHITECTURES 9

Protocols – layered approach – OSI Model – Hierarchical Approach –Bus / Tree Topology – Ring topology Medium access protocols: Aloha & CSMA/CD – IEEE802, 803 standards

UNIT II NETWORK ACCESS PROTOCOL & INTERNETWORKING 9

Circuits switched Network access – packet switched network access- Broadcast network access principles of internetworking – Bridges, Gateways – Internet protocols - Internet protocol versions.

UNIT III TRANSPORT PROTOCOL & ROUTING TECHNIQUES 9

Transport services & Protocol mechanisms – TCP- UDP – Comparison of TCP & UDP Overview of routing techniques

UNIT IV PRESENTATION / APPLICATION PROTOCOLS 9

File transfer protocols – World Wide Web – Electronic mail – Overview of ISDN-ISDN protocols -Cryptography.

UNIT V NETWORK MANAGEMENT 9

Architecture of network management – Congestion control algorithms – Network Security – DES Algorithm –RSA Algorithm Signature – Authentication & Certificates.

Total periods: 45

Reference Books:

1. Stallings, "Data and Computer Communication" Maxwell and Macmillan, 1998
2. Andrew Tannenbaum S, "Computer Networks" 3rd Edition prentice Hall of India, 1997.
3. Stalling, "Computer Communication Architecture, Protocols and Standards", IEEE computer society 1987
4. Kemel Texpian A.S. "Communication Network Management" Prentice Hall, 1992
5. Uyters Black , "Network Management Standards", McGraw Hill 1995
6. Commer and Stevans "Internetworking with TCP / IP Vol.III: Client server programming and applications", Prentice Hall USA, 1994.

MPE015	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours:	3	0	0	3
	Prerequisite:				
	Course Designed by : Department of Electronics and Communication Engineering				

OBJECTIVES To develop skills for analyzing and synthesizing algorithms and systems that pro discrete time signals, with emphasis on realization and implementation.

COURSE OUTCOMES (COs)

CO1	Represent discrete-time signals analytically and visualize them in the time domain.
CO2	Understand the meaning and implications of the properties of systems and signals.
CO3	Understand the Transform domain and its significance and problems related to computational complexity.
CO4	Be able to specify and design any digital filters using MATLAB.
CO5	Understand programmable DSP chips & applications

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1		L	L		
	CO2	H				M
	CO3		M	H		
	CO4			H		
	CO5	H			L	
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37^{th}, 38^{th} & 39^{th} Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I

DISCRETE TIME SIGNALS AND SYSTEMS 9

Periodic and pulse signals – examples of sequence – pulse step, impulse, ramp, sine and exponential – differential equations – lincar time invariant – stability, causality – DT systems – time domain analysis.

UNIT II

TRANSFORM 9

Z-transform and its properties – convolution – inverse Z-transform-discrete Fourier series – properties – sampling the Z-transform – discrete Fourier transform – properties for frequency domain analysis linear convolution using discrete Fourier transform overlap add method, over lap save method.

UNIT III

FAST FOURIER TRANSFORM (FFT) 9

Introduction to Radix 2 FFT's – decimation in time FFT algorithm – decimation in frequency FFT algorithm – computing inverse DFT using FFT – Introduction to Radx4FFTs decimation in time FFT algorithm – decimation in frequency FFT

UNIT IV

IIR UR AND FIR FILTER DESIGN 12

Classification – reliability constrains – IIR design – bilinear transform method – impulse invariant method step invariance method FIR design Fourier series method window function method – triangular window – rectangular window – hamming window – hanning window – keiser window

UNIT V

PROGRAMMABLE DSP CHIPS & APPLICATIONS 6

Architecture and features of TMS320c26 and ADSP 2181 signal processing chips. Introduction to stenography – image processing.

Total Periods: 45

Text Books

1. Openneim A.V and Shalter R.S. "Discrete Time Signal Processing" Prentice hall NJ, 1980.
2. Proakis J.G. and manolakis D.G. "Introductin to Digital Signal Processing Maxwell Mcwilliams International Edition London 1989.

References:

1. Stanley W.D. "Digital Signal Processing" Restion Publishing House 1989.

2. Sanjit K. Mitra "Digital Signal Processing- a Computer based approach" Tata McGraw Hill Publishing Co., 2001.
3. Antonia A "Digital Filters Analysis & Design" Tata McGraw Hill Publishing Co., New Delhi 1998.

MST070	**RESEARCH METHODOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours: 45	**3**	**0**	**0**	**3**
	Prerequisite: Professional Courses				
	Course Designed by :Department of civil				

OBJECTIVESTo know the various types of Formulation of Research Task,modeling and simulation, analysis of reports and report writing.

COURSE OUTCOMES (COs)

CO1	To understand the basic concept ofFormulation of Research Task.
CO2	To have knowledge about mathematical modeling and simulation
CO3	To understand experimental modeling.
CO4	To know about of analysis of report.
CO5	To know about of concept of report writing.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e
2	CO1	M	M			
	CO2	H	M		L	
	CO3	H	M			
	CO4	M	M		L	L
	CO5	M	M	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37th, 38th& 39thMeeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT-I RESEARCH CONCEPTS 9

Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental).

Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts, Hypothetical proposals for future development and testing, selection of Research task.

UNIT-II MATHEMATICAL MODELING AND SIMULATION 9

Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Difference Equations, Partial Differential equations, Graphs, Simulation, Process of formulation of Model based on Simulation.

UNIT-III EXPERIMENTAL MODELING 9

Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Methods for study of response surface, determining optimum combination of factors, Taguchi approach to parameter design.

UNIT-IV ANALYSISF REULTS 9

Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance, multiple regression, testing linearity and non-linearity of model.

UNIT-V REPORT WRITING 9

Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, references, tables, figures, conclusion, appendices.

Total No. of Periods: 45

TEXT BOOKS

1. Willktnsion K. L, Bhandarkar P. L, „Formulation of Hypothesis‟, Himalaya Publication.
2. Schank Fr., „Theories of Engineering Experiments‟, Tata Mc Graw Hill Publication.

REFERENCE BOOKS

1. Douglas Montgomary, „Design of Experiments‟, Statistical Consulting Services, 1990.
2. Douglas H. W. Allan, „Statistical Quality Control: An Introduction for Management‟, Reinhold Pub Corp, 1959.
3. Cochran and Cocks, „Experimental Design‟, John Willy & Sons.
4. John W. Besr and James V. Kahn, „Research in Education‟, PHI Publication.
5. Adler and Granovky, „Optimization of Engineering Experiments‟, Meer Publication.
6. S. S. Rao, „Optimization Theory and Application‟, Wiley Eastern Ltd., New Delhi, 1996.