MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Accredited by NAAC, NBA & Affiliated to Anna University)

Rasipuram - 637 408, Namakkal Dist., Tamil Nadu.

Curriculum/Syllabus

Programme Code : PED

Programme Name : M.E-Power Electronics and Drives

Regulation : R-2016

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Rasipuram - 637 408, Namakkal Dt, Tamil Nadu.

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INSTUTION VISION &MISSION

INSTUTION VISION

To be a Centre of Excellence in Engineering, Technology and Management on par with International Standards.

INSTUTION MISSION

- To prepare the students with high professional skills and ethical values
- To impart knowledge through best practices
- To instill a spirit of innovation through Training, Research and Development
- To undertake continuous assessment and remedial measures
- To achieve academic excellence through intellectual, emotional and social stimulation

INSTUTIONMOTTO

Rural upliftment through Technical Education.

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DEPARTMENT VISION & MISSION

DEPARTMENT VISION

To produce competent Electrical and Electronics Engineers with advanced skills and knowledge to contribute the society.

DEPARTMENT MISSION

- To establish the advance laboratories to enable the students to face the challenges in Electrical and Electronics industries
- To enable collaborative research in contemporary and sustainable technologies in Electrical and Electronics Engineering
- To produce Electrical and Electronics Engineering graduates with quest for excellence, enthusiasm for continuous learning, ethical behavior, integrity and exceptional leadership

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DEPARTMENT PROGRAM EDUCATIONAL OBJECTIVES, PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

PROGRAM EDUCATIONAL OBJECTIVES

The Electrical and Electronics Engineering Graduates should be able to

PEO1: Practice as an Engineer in the Electrical and Electronics industries and become an entrepreneur

PEO2: Pursue higher education and research for professional development

PEO3: Exhibit the leadership skills and ethical value for society

PROGRAM OUTCOMES

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
3. **Design/Development solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES

PSO1: Apply mathematical and engineering knowledge for designing Electrical and Electronics systems

PSO2: Derive sustainable solutions for complex Electrical and Electronics Engineering problems

PSO3: Use modern software tools and techniques related to Electrical and Electronics Engineering industry

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Department	Electrical and Electronics Engineering	
Programme	M.E- Power Electronics and Drives	

FOUNDATION COURSE

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PEA01	Advanced Numerical Methods	FC	5	3	2	0	4
2.	16PEA02	Applied Mathematics	FC	5	3	2	0	4
3.	16PEA03	Applied Probability and Statistics	FC	5	3	2	0	4

PROFESSIONAL CORE

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PEB01	Advanced Power Semiconductor Devices	PC	3	3	0	0	3
2.	16PEB02	Design and Analysis of Power Converters	PC	5	3	0	2	4
3.	16PEB03	Design and Analysis of Inverters	PC	3	3	0	0	3
4.	16PEB04	Modeling and Analysis of Electrical Machines	PC	5	3	2	0	4
5.	16PEB05	Solid State DC Drives	PC	3	3	0	0	3
6.	16PEB06	Solid State AC Drives	PC	3	3	0	0	3
7.	16PEB07	Special Electrical Machines and Controllers	PC	5	3	0	2	4
8.	16PEB08	Power Quality	PC	3	3	0	0	3
9.	16PEB09	Advanced Digital Signal Processing	PC	3	3	0	0	3
10.	16PEB10	Emerging trends in power conversion technology	PC	3	3	0	0	3
11.	16PEB11	SMPS and UPS	PC	3	3	0	0	3
12.	16PEB12	Computer Aided Design of Electric Drives	PC	3	3	0	0	3

PROFESSIONAL ELECTIVE

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PEC01	Linear and Non Linear Systems Theory	PE	3	3	0	0	3
2.	16PEC02	Microcontroller Based System Design	PE	3	3	0	0	3
3.	16PEC03	Electromagnetic Field Computation and Modeling	PE	3	3	0	0	3
4.	16PEC04	Flexible AC Transmission Systems	PE	3	3	0	0	3
5.	16PEC05	VLSI Architecture and Design Methodologies	PE	3	3	0	0	3
6.	16PEC06	Energy Management and Auditing	PE	3	3	0	0	3

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7.	16PEC07	High Voltage Direct Current Transmission	PE	3	3	0	0	3
8.	16PEC08	Application of MEMS Technology	PE	3	3	0	0	3
9.	16PEC09	Solar and Energy Storage Systems	PE	3	3	0	0	3
10	16PEC10	Wind Energy Conversion Systems	PE	3	3	0	0	3
11.	16PEC11	Non Linear Dynamics for Power Electronics Circuits	PE	3	3	0	0	3
12.	16PEC12	Smart Grid	PE	3	3	0	0	3
13.	16PEC13	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3
14.	16PEC14	Real Time Operating System	PE	3	3	0	0	3
15.	16PEC15	Soft Computing Techniques	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PED01	Project Work-Phase I	EEC	12	0	0	12	6
2.	16PED02	Project Work-Phase II	EEC	24	0	0	24	12

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SEMESTER – I

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1.	16PEA01	Applied Mathematics	FC	5	3	2	0	4	50	50	100
2.	16PEB01	Advanced Power Semiconductor Devices	PC	3	3	0	0	3	50	50	100
3.	16PEB02	Design and Analysis of Power Converters	PC	5	3	0	2	4	100	100	200
4.	16PEB03	Design and Analysis of Inverters	PC	3	3	0	0	3	50	50	100
5.	16PEB04	Modeling and Analysis of Electrical Machines	PC	5	3	2	0	4	50	50	100
6.		Elective-I	PE	3	3	0	0	3	50	50	100
Total Credits								**21**	**700**		

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Programme	M.E – Power Electronics and drives	

SEMESTER – II

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1.	16PEB05	Solid State DC Drives	PC	3	3	0	0	3	50	50	100
2.	16PEB06	Solid State AC Drives	PC	3	3	0	0	3	50	50	100
3.	16PEB07	Special Electrical Machines and controllers	PC	5	3	0	2	4	100	100	200
4.	16PEB08	Power Quality	PC	3	3	0	0	3	50	50	100
5.		Elective-II	PE	3	3	0	0	3	50	50	100
6.		Elective-III	PE	3	3	0	0	3	50	50	100
Total Credits								**19**	**700**		

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Programme	M.E – Power Electronics and drives	

SEMESTER – III

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1.		Elective -IV	PE	3	3	0	0	3	50	50	100
2.		Elective-V	PE	3	3	0	0	3	50	50	100
3.		Elective-VI	PE	3	3	0	0	3	50	50	100
4.	16PED01	Project Work - Phase I	EEC	12	0	0	12	6	50	50	100
Total Credits								**15**	**400**		

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Programme	M.E – Power Electronics and drives	

SEMESTER – IV

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1	16PED02	Project Work - Phase II	EEC	24	0	0	24	12	50	50	100
Total Credits								**12**	**100**		

TOTAL CREDITS -67

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16PEA01 ADVANCED NUMERICAL METHODS

COURSE OBJECTIVES

- To learn the algebraic equations which finds applications in many engineering branches.
- To make the student acquire sound knowledge of computational techniques in solving ordinary differential equations that model engineering.
- To introduce numerical tools for the solutions of partial differential equations that model several physical processes
- To impart knowledge on numerical methods that will come in handy to solve numerically the problems that arise in engineering and technology.
- To deal with interpolation and approximation for the application of finite element analysis

COURSE OUTCOMES

- Since the focus is on the techniques themselves, rather than specific applications, the contents should be relevant to varied fields such as engineering, management, economics, etc.
- The students will have a clear perception of the power of numerical Techniques. This will also serve as a precursor for future research.
- This course makes students easy in solving boundary value problems
- Students would be able to demonstrate the applications of numerical techniques to problems drawn from industry, management and other engineering fields.
- The students will have the ability to do finite element analysis of mechanical structural analysis problems.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEA01.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PEA01.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEA01.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEA01.CO4	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEA01.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	2	-

L	T	P	C
3	2	0	4

UNIT I ALGEBRAIC EQUATIONS **15**

Systems of linear equations: Gauss Elimination method, pivoting techniques, Thomas algorithm for tridiagonal system – Jacobi, Gauss Seidel, SOR iteration methods - Systems of nonlinear equations: Fixed point iterations, Newton Method, Eigenvalue problems: power method, inverse power method, Faddeev – Leverrier Method.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS **15**

Runge Kutta Methods for system of IVPs, numerical stability, Adams - Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT III FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATION **15**

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation - Dirichlet and Neumann conditions – Two dimensional parabolic equations – ADI method; First order hyperbolic equations – method of characteristics, different explicit and implicit methods;

UNIT IV FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS **15**

Laplace and Poisson's equations in a rectangular region: Five point finite difference schemes, Leibmann's iterative methods, Dirichlet and Neumann conditions – Laplace equation in polar coordinates: finite difference schemes

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UNIT V FINITE ELEMENT METHOD **15**

Partial differential equations – Finite element method - orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

TOTAL: 75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Saumyen Guha and Rajesh Srivastava	Numerical methods for Engineering and Science	Oxford Higher Education	2010
2.	Gupta S.K.	Numerical Methods for Engineers	New Age Publishers	1995
3.	Burden, R.L., and Faires, J.D.	Numerical Analysis –Theory and Applications	Cengage Learning, India Edition	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jain M. K., Iyengar S. R., Kanchi M. and B., Jain	Computational Methods for Partial Differential Equations	New Age Publishers	1993
2.	Morton K.W. and Mayers D.F.	Numerical solution of partial differential equations	Cambridge University press	2002

WEB URLs

1. http://nptel.ac.in/courses/103101111/downloads/Lecture-notes/Module_4_Solving_Ax=b.pdf
2. www.youtube.com/watch?v=FmhMUTmUjhM
3. https://mat.iitm.ac.in/home/sryedida/public_html/caimna/pde/fifth/example.html
4. www.youtube.com/watch?v=BERb9PRiVB4
5. www.math.tifr.res.in/~publ/ln/tifr49.pdf

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16PEA02 APPLIED MATHEMATICS

COURSE OBJECTIVES

- To realize the use of matrix theory techniques in engineering applications and to develop for future applications.
- To learn concepts the calculus of variations.
- To introduce the basic concepts of one dimensional Random Variables.
- To formulate and construct a mathematical model for a linear programming problem in real life situation.
- To introduce Fourier series analysis this is central to many applications in engineering.

COURSE OUTCOMES

- This course equips students to have basic knowledge in matrix theory techniques with its engineering applications
- Helps to find approximate solutions for various engineering problems
- It also helps to understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- The knowledge gained on this course helps the students to do engineering optimization.
- Provides the students to have sound knowledge Fourier series analysis.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEA02.CO1	X	X	X	X	X	-	-	-	X	-	-	X	-	X	-
16PEA02.CO2	X	X	X	X	X	-	-	-	X	-	-	X	-	X	-
16PEA02.CO3	-	-	X	X	X	-	-	-	-	-	-	X	-	X	-
16PEA02.CO4	-	-	X	X	X	-	-	-	-	-	-	X	-	X	-
16PEA02.CO5	-	-	X	X	X	-	-	-	-	-	-	X	-	X	-

L	T	P	C
3	2	0	4

UNIT I MATRIX THEORY **15**

The Cholesky decomposition - Generalized Eigen vectors, Canonical basis - QR factorization - Least squares method - Singular value decomposition.

UNIT II CALCULUS OF VARIATIONS **15**

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – problems with constraints - Direct methods: Ritz and Kantorovich methods.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES **15**

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT IV LINEAR PROGRAMMING **15**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models.

UNIT V FOURIER SERIES AND EIGEN VALUE PROBLEMS **15**

Fourier Trigonometric series: Periodic function as power signals – Convergence of series – Even and odd function: cosine and sine series – Non-periodic function: Extension to other intervals - Power signals: Exponential Fourier series – Parseval's theorem and power spectrum – Eigen value problems and orthogonal functions – Regular Sturm-Liouville systems – Generalized Fourier series.

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TOTAL: 75

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Richard Bronson .	Matrix Operation	Schaum's outline series, McGraw Hill	2011
2.	Gupta, A.S.	Calculus of Variations with Applications	Prentice Hall of India Pvt. Ltd	1997
3.	Oliver C. Ibe.	Fundamentals of Applied Probability and Random Processes	Academic Press	2010

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Taha, H.A.	Operations Research- An introduction	Pearson education	2010
2.	Andrews L.C. and Phillips R.L.	Mathematical Techniques for Engineers and Scientists	Prentice Hall of India Pvt.Ltd	2005

WEB URLs

1. http://nptel.ac.in/courses/111108066/
   http://www.cs.utexas.edu/~pingali/CS378/2011sp/lectures/chol4.pdf
2. http://www.math.uni-leipzig.de/~miersemann/variabook.pdf
3. http://nptel.ac.in/courses/IIT-MADRAS/Principles_of_Communication1/Pdfs/1_5.pdf
4. http://nptel.ac.in/courses/111104027/
5. http://nptel.ac.in/courses/111106046/

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16PEA03 APPLIED PROBABILITY AND STATISTICS

COURSE OBJECTIVES

- To introduce the basic concepts of one dimensional and two dimensional Random Variables.
- To provide information about Estimation theory, Correlation, Regression.
- To understand concepts of testing of hypothesis
- To enable the students to use the concepts of multivariate normal distribution and principle components analysis.
- To understand multivariate analysis in the probability.

COURSE OUTCOMES

- It also helps to understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- Provides knowledge to apply testing of hypothesis to real life problems.
- This chapter enhances the students to do a systematic and scientific research.
- Since the focus is on the techniques themselves, rather than specific applications, the contents should be relevant to varied fields such as engineering, management, economics, etc.
- Understand multivariate analysis in the probability.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEA03.CO1	X	-	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEA03.CO2	X	-	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEA03.CO3	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEA03.CO4	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEA03.CO5	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X

L	T	P	C
3	2	0	4

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 15

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 15

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 15

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 15

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 15

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components Population principal components – Principal components from standardized variables.

TOTAL: 75

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Jay L. Devore	Probability and Statistics For Engineering and the Sciences	Thomson and Duxbury	2002
2.	Richard Johnson	Miller & Freund's Probability and Statistics for Engineer	Prentice – Hall Seventh Edition	2007
3.	RichardA. Johnson and Dean W. Wichern	Applied Multivariate Statistical Analysis	Pearson Education	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gupta S.C. and Kapoor V.K.	Fundamentals of Mathematical Statistics	Sultan an Sons	2001
2.	Dallas E Johnson	Applied Multivariate Methods for Data Analysis	Thomson an Duxbury press	1998

WEB URLs

1. http://www.maths.qmul.ac.uk/~pettit/MAS109/chp4.pdf
2. http://nptel.ac.in/courses/111105041/
3. http://nptel.ac.in/courses/117104117/
4. http://www.efunda.com/math/leastsquares/leastsquares.cfm
5. http://nptel.ac.in/courses/111105041/33
6. http://nptel.ac.in/courses/110105060/

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16PEB01 ADVANCED POWER SEMICONDUCTOR DEVICES

COURSE OBJECTIVES

- To understand the operating regions of different switching devices
- To understand the static and dynamic characteristics of current controlled power semiconductor devices
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices.
- To enable the students for the selection of devices for different power electronics applications
- To understand the control and firing circuit for different devices

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Analyze the characteristics of power semiconductor devices
- Explain the basic principle and operation of thyristor.
- Demonstrate the principle and operation of current and voltage controlled devices.
- Design and analyze firing and protection circuits.
- Understand the control and firing circuit for different devices

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB01.CO1	X	-	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEB01.CO2	X	-	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEB01.CO3	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEB01.CO4	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X
16PEB01.CO5	X	X	X	-	X	-	-	-	X	X	X	X	-	-	X

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols , Power handling capability – safe operating area ; Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

UNIT II CURRENT CONTROLLED DEVICES 9

BJT's – Construction, static characteristics, switching characteristics; Negative temperature co- efficient and secondary breakdown; Power Darlington - Thyristor – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor.

UNIT III VOLTAGE CONTROLLED DEVICES 9

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs -Basics of GTO, MCT, FCT, RCT and IGCT.

UNIT IV FIRING AND PROTECTION CIRCUITS 9

Necessity of isolation, Pulse transformer, and Opto coupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubber.

UNIT V THERMAL PROTECTION 9

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

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TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rashid M.H	Power Electronics Circuits, Devices and Applications, Third Edition	Prentice Hall India, New Delhi	2004
2.	MD Singh and K.B Khanchandani	Power Electronics	Tata McGraw Hill	2001

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mohan, Undeland and Robins	Power Electronics – Concepts, applications and Design	John Wiley and Sons, Singapore	2000
2.	Andrews L.C. and Phillips R.L	Mathematical Techniques for Engineers and Scientists	Prentice Hall of India Pvt.Ltd. New Delhi	2005
3.	B.W Williams	Power Electronics Circuit Devices and Applications	-	-

WEB URLs

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   https://www.physicsforums.com/threads/why-is-fet-voltage-controlled-and-bjt-current-controlled.335368/
2. http://www.geekinterview.com/question_details/55408
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16PEB02 DESIGN AND ANALYSIS OF POWER CONVERTERS

COURSE OBJECTIVES

- To provide the electrical circuit concepts behind the different working modes of power converters so as to enable deep understanding of their operation.
- To equip with required skills to derive the criteria for the design of power converters starting from basic fundamentals.
- To analyze and comprehend the various operating modes of different configurations of power converters.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters.
- To design cycloconverter with different configurations.

COURSE OUTCOMES

- Demonstrate the basic concept of steady state operation of single and three phase AC-DC converters.
- Analyze the operation of various DC-DC converters.
- Analyze the operation of AC voltage controllers.
- Analyze the operation of cycloconverter.
- Design cycloconverter with different configurations.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB02.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB02.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEB02.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEB02.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEB02.CO5	-	X	X	-	-	-	-	-	-	X	-	X	X	-	-

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UNIT I SINGLE PHASE AC-DC CONVERTER 9

Static Characteristics of power diode, SCR and GTO, half controlled and fully controlled converters with R-L, R-L-E loads and freewheeling diodes – continuous and discontinuous modes of operation - inverter operation – performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits-active and passive filter for harmonic mitigation.

UNIT II THREE PHASE AC-DC CONVERTER 9

Semi and fully controlled converter with R, R-L, R-L-E - loads and freewheeling diodes – inverter operation and its limit – performance parameters – effect of source impedance and overlap – design of converter circuit-PSCICE simulation of converters.

UNIT III DC-DC CONVERTERS 9

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost, Cuk, SEPIC & ZETA converters – Full bridge converter – Resonant and quasi – resonant converters.

UNIT IV AC VOLTAGE CONTROLLERS 9

Principle of phase control: single phase and three phase controllers – various configurations – analysis with R and R-L loads - design of AC controller circuits.

UNIT V CYCLOCONVERTERS 9

Principle of operation – Single phase and Three-phase Dual converters - Single phase and three phase cyclo-converters – power factor Control – Introduction to matrix converters.

TOTAL: 45

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LIST OF EXPERIMENTS

1. Simulation of Single phase Semi converter
2. Simulation of Single phase Fully controlled converter.
3. Simulation of Three phase semi converter
4. Simulation of Three phase fully controlled converter
5. Simulation of Single phase Dual converter
6. Simulation of Single phase full bridge Inverter
7. Simulation of Single phase half bridge Inverter
8. Simulation of Three phase full bridge inverter.
   a) 180 degree mode of operation
   b) 120 degree mode of operation
9. Simulation of single phase AC Voltage Controller.
10. Simulation of Three phase AC Voltage Controller.
11. Simulation of PWM inverter
    a) Sinusoidal PWM
    b) Square PWM

TOTAL: 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ned Mohan,T.M Undeland and W.P Robbin	Power Electronics: converters, Application and design	John Wiley and sons.Wiley India edition	2006
2.	Rashid M.H	Power Electronics Circuits, Devices and Applications, Third Edition	Prentice Hall India, New Delhi	2004
3.	Cyril W.Lander	Power electronics, Third Edition	McGraw hill	1993

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P.C Sen	Modern Power Electronics	Wheeler publishing Co, First Edition, New Delhi	1998
2.	P.S.Bimbra	Power Electronics	Khanna Publishers, Eleventh Edition	2003
3.	Vedam Subraanyam	Power Electronics, Second Edition	New Age International publishers, New Delhi	2006

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2. www.nptel.ac.in/courses/Webcourse.../L- 3(DK)(PE)%20((EE)NPTEL)%20.pdf
3. https://www.maximintegrated.com/en/app-notes/index.mvp/id/2031
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5. https://en.wikipedia.org/wiki/Cycloconverter
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16PEB03 DESIGN AND ANALYSIS OF INVERTERS

COURSE OBJECTIVES

- To provide the electrical circuit concepts behind the different working modes of inverters so as to enable deep understanding of their operation.
- To equip with required skills to derive the criteria for the design of power converters for UPS, Drives etc.,
- Ability to analyze and comprehend the various operating modes of different configurations of power converters.
- Ability to design different single phase and three phase inverters.
- To Analyze the resonant inverter

COURSE OUTCOMES

- Provide the electrical circuit concepts behind the different working modes of inverters soas to enable deep understanding of their operation.
- Equip with required skills to derive the criteria for the design of power converters for UPS, Drives etc.,
- Analyze and comprehend the various operating modes of different configurations ofpower converters.
- Design different single phase and three phase inverters.
- Analyze the resonant inverter

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB03.CO1	X	X	-	-	X	-	-	-	-	-	-	-	X	-	-
16PEB03.CO2	X	X	-	X	X	-	-	-	-	-	-	X	X	-	-
16PEB03.CO3	X	X	X	-	X	-	-	-	-	-	-	X	X	X	-
16PEB03.CO4	X	X	X	X	X	-	-	-	-	-	-	-	-	X	-
16PEB03.CO5	X	X	X	-	X	-	-	-	-	-	-	-	X	X	-

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UNIT I BASIC INVERTERS 9

Basic series inverter – Modified series inverter- High frequency series inverter- Design of L and C – Parallel inverter- Design of parallel inverter- Line commutated inverter – Concepts of PWM techniques- SPWM , Multi-PWM , Carrier based PWM , Space vector PWM.

UNIT II VOLTAGE SOURCE INVERTERS 9

Principle of operation of half and full bridge inverters – Three phase inverters with 180 degree and 120 degree conduction mode with star and delta connected loads- Performance parameters – Voltage control of single phase and three phase inverters – Various harmonic elimination techniques.

UNIT III CURRENT SOURCE AND IMPEDANCE SOURCE INVERTERS 9

Load commutated current source inverter- Single phase and three phase Auto Sequential Current Source Inverter (ASCI) – Principle of operation of impedance source inverter- Shoot through zero state – Comparison of current source inverter, Voltage source inverters and impedance source inverter.

UNIT IV MULTILEVEL INVERTERS 9

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters – Hybrid multi-level inverter- FFT analysis- Comparison of multilevel inverters - Applications of multilevel inverters.

UNIT V RESONANT INVERTERS 9

Concept of Zero Voltage Switching and Zero Current Switching - Series and parallel resonant inverters- Voltage control of resonant inverters – Class E resonant inverter – Resonant DC Link inverters.

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rashid M.H	Power Electronics Circuits, Devices and Applications, Third Edition	Prentice Hall India, New Delhi	2004
2.	Jai P.Agrawal	Power Electronics Systems	Pearson Education	2002
3.	Bimal K.Bose	Modern Power Electronics and AC Drives	Pearson Education	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mohan, Undcland and Robins	Power Electronics – Concepts, applications and Design	John Wiley and Sons, Singapore	2000
2.	Philip T. krein	Elements of Power Electronics	Oxford University Press	1998
3.	P.C. Sen	Modern Power Electronics	Wheeler Publishing Co, New Delhi	1998
4.	P.S.Bimbra	Power Electronics	Khanna Publishers	2003

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3. https://en.wikipedia.org/wiki/Z-source_inverter
4. https://www.elprocus.com/multilevel-inverter-types-advantages/
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16PEB04 MODELING AND ANALYSIS OF ELECTRICAL MACHINES

COURSE OBJECTIVES

- To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
- To analyze the steady state and dynamic state operation of DC machine through mathematical modeling.
- To provide the knowledge about theory of transformation of three phase variables to two phase variables.
- To analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling.
- To analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Analyze the steady state and dynamic state operation of DC machine through mathematical modeling
- Analyze the theory of transformation of three phase variables to two phase variables.
- Analyze the steady state and dynamic state operation of three-phase induction machines and synchronous machines.
- Analyze the steady state and dynamic state operation of three-phase induction machines and synchronous machines.
- Analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB04.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB04.CO2	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB04.CO3	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB04.CO4	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB04.CO5	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-

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UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 12

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 12

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 block diagrams - Solution of dynamic characteristic by Laplace transformation – Digital computer simulation of permanent magnet and shunt D.C. machines.

UNIT III REFERENCE FRAME THEORY 12

Historical background – Phase transformation and commutator transformation – Transformation of variables from stationary to arbitrary reference frame - Variables observed from several frames of reference

UNIT IV INDUCTION MACHINES MODELING 12

Static and rotating References: frames, transformation relationships - Stationary circuit Variables transformed to the arbitrary Reference frame treating R, L, C elements separately - Application of

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Reference frame theory to three phase symmetrical induction machine - Direct and quadrature axis model in arbitrarily rotating Reference frame - Voltage and torque equations.

UNIT V SYNCHRONOUS MACHINES MODELING 12

Application of reference frame theory to three phase synchronous machine- Dynamic model analysis- Parks equation - Voltage and torque equations - Deviation of steady state phasor relationship from dynamic model -Generalized theory of rotating electrical machine and Krons primitive machine.

TOTAL: 60

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff	Analysis of Electric Machinery and Drive Systems, Second Edition	John Wiley	2010
2.	A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx	Electric Machinery, 5th Edition	Tata McGraw Hill	1992

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P S Bimbhra	Generalized Theory of Electrical Machines	Khanna Publishers	2008
2.	Bimal K Bose	Modern Power Electronics and AC Drives	Prentice-Hall of India Pvt. Ltd., New Delhi	2003

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16PEB05 SOLID STATE DC DRIVES

COURSE OBJECTIVES

- To impart knowledge on the operation and analysis of DC Motors.
- To make the students analyze the operation of controlled rectifier fed DC Drives.
- To make the students analyze the operation of Chopper fed DC Drives.
- To make the students understand the current and speed controllers for closed loop solid state DC motor drives.
- To understand the digital controller and dc drives

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Explain the basic concept of steady state operation and transient dynamics of a motor load system
- Design and analyze the operation of the various controlled rectifier fed DC drives.
- Design and analyze the operation of the various chopper fed DC drives
- Design and analyze the current and speed controllers for closed loop solid state DC motor drives.
- Understand the digital controller and dc drives

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB05.CO1	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEB05.CO2	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEB05.CO3	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEB05.CO4	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEB05.CO5	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-

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UNIT I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS 9

DC motor- Types, induced emf, speed-torque relations; Speed control – Armature and field control-Ward Leonard control – Braking methods- Constant torque and constant horse power operation. Characteristics of mechanical system – Dynamic equations, components of torque, types of load-Requirements of drives characteristics - stability of drives – Multi-quadrant operation- Drive elements, types of motor duty and selection of motor rating.

UNIT II CONVERTER FED DC DRIVES 9

Principle of phase control – Fundamental relations - Analysis of series and separately excited DC motor with single-phase and three-phase converters – Waveforms, performance parameters, performance characteristics. Continuous and discontinuous mode, Current ripple and its effect on performance-Operation with freewheeling diode, Dual converter fed DC drives-related problems.

UNIT III CHOPPER FED DC DRIVES 9

Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – Performance analysis, multi-quadrant control - Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT IV CLOSED LOOP CONTROL 9

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed D.C drive.

UNIT V DIGITAL CONTROL OF DC DRIVE AND APPLICATIONS 9

Programmable Logic Controller and micro-computer control of DC drives; Applications -Rolling mills, Traction, Solar powered pump drives, Battery powered vehicles.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G. K Dubey	Power Semiconductor controlled Drives	Prentice Hall Inc., New Jersy	1989
2.	R.Krishnan	Electric Motor Drives – Modeling, Analysis and Control	Prentice-Hall of India Pvt. Ltd., New Delhi	2010
3.	G. K.Dubey	Fundamentals of Electrical Drives, Second Edition	Narosa Publishing House, New Delhi	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Vedam Subramanyam	Electric Drives – Concepts and Applications, Second Edition	Tata McGraw Hill	2010
2.	P.C Sen	Thyristor DC Drives	John wiley and sons, New York	1981

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1. http://freevideolectures.com/Course/2335/Basic-Electrical-Technology/26
2. https://www.youtube.com/watch?v=bWXZKBMG3KY
3. http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/32
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16PEB06 SOLID STATE AC DRIVES

COURSE OBJECTIVES

- To impart knowledge on operation and analysis of three phase Induction Motors and Synchronous Motors.
- To make the students analyze the operation of AC Voltage controller fed AC Drives.
- To make the students analyze the operation of VSI and CSI fed AC Drives.
- To make the students understand the operation of the speed control of induction motor drive from the rotor side.
- To make the students understand the field oriented control of induction machines.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Be familiar with the concept of various operating regions of the induction motor drives.
- Design and Analyze the operation of AC voltage controller fed induction motor drives.
- Design and Analyze the operation of VSI & CSI fed induction motor control.
- Design and Analyze the operation of the speed control of induction motor drive from the rotor side.
- Understand the field oriented control of induction machines.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB06.CO1	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEB06.CO2	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEB06.CO3	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEB06.CO4	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEB06.CO5	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-

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UNIT I FUNDAMENTALS OF AC MOTORS 9

Steady state performance equations- Rotating Magnetic Field- Torque production, Equivalent circuit- Performance of the machine with Variable Voltage-Variable frequency operation, constant Volt/Hz operation, Slip power recovery – Static Kramer Drive - Synchronous Drives.

UNIT II VSI AND CSI FED INDUCTION MOTOR CONTROL 9

AC voltage control circuit- Six step inverter voltage control- Closed loop variable frequency- PWM inverter with dynamic braking- CSI fed IM variable frequency drives- comparison.

UNIT III FIELD ORIENTED CONTROL 9

Field oriented control of induction machines- Theory-DC analogy- Direct or feedback vector control- Indirect or feed forward vector control- Flux vector estimation- Space vector modulation control.

UNIT IV DIRECT TORQUE CONTROL 9

Direct torque control of induction machines- Torque expression with stator and rotor fluxes, DTC control strategy- Optimum switching vector selection- reduction or torque ripple methods.

UNIT V SYNCHRONOUS MOTOR DRIVES 9

Wound field cylindrical rotor motor- Equivalent circuit –Performance equations of operation from a voltage source- Power factor control and V curves- Starting and braking, self-control – Load Commutated Synchronous motor drives – Brush and Brushless excitation.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Bimal K. Bose	Modern Power Electronics and AC Drives	Prentice-Hall of India Pvt. Ltd., New Delhi	2003
2.	Vedam Subramanyam,	Electric Drives – Concepts and Applications, Second Edition	Tata McGraw Hill	2010
3.	Gobal K.Dubey	Fundamentals of Electrical Drives, Second Edition	Narosa Publishing House, New Delhi	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Gopal K Dubey	Power Semiconductor controlled Drives	Prentice Hall Inc., New Jersy	1989
2.	R.Krishnan	Electric Motor Drives – Modeling, Analysis and Control	Prentice-Hall of India Pvt. Ltd., New Delhi	2003

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3. https://www.youtube.com/watch?v=2jtk1_rcYYQ
4. https://www.youtube.com/watch?v=CTM7ve7hBJE
5. https://www.youtube.com/watch?v=b24jORRoxEc

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16PEB07 SPECIAL ELECTRICAL MACHINES AND CONTROLLERS

COURSE OBJECTIVES

- To impart knowledge on the constructional features and operating principles of various types of special electrical machines.
- To make the students compare and analyze the static and dynamic characteristics of special electrical machines.
- To provide knowledge on the different types of drive systems and controllers used in special electrical machines.
- To make the students understand the current and speed controllers for closed loop solid state DC motor drives.
- To understand the digital controller and dc drives

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Describe the construction and operating principles of special electrical machines.
- Analyze the characteristics and performance of special electrical machines.
- Analyze the different types of controllers and control techniques.
- Design and analyze the current and speed controllers for closed loop solid state DC motor drives.
- Understand the digital controller and dc drives

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB07.CO1	X	-	X	-	-	X	X	-	-	X	-	X	-	-	-
16PEB07.CO2	X	X	-	-	X	X	-	-	-	X	-	X	X	-	X
16PEB07.CO3	X	X	X	-	X	X	X	-	X	X	-	X	X	-	X
16PEB07.CO4	X	X	X	-	X	X	X	-	X	X	-	X	X	-	X
16PEB07.CO5	X	X	-	-	X	X	-	-	-	X	-	X	-	-	X

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UNIT I STEPPING MOTORS 9

Principle of operation – classification – Construction and operation: VR motor, permanent magnet stepping motor, hybrid stepping motor. Mono filar and bifilar windings, static characteristics – Dynamic characteristics – Modes of excitation- micro stepping – Applications.

UNIT II SWITCHED RELUCTANCE MOTOR 9

Construction – Principle of operation – SRM Vs stepper motor, poles, phase and windings – Static torque production – Energy conversion loop – Partition of energy and effect of saturation – Converter circuits, controls: current regulation, commutation, torque speed characteristics.

UNIT III BRUSHLESS DC MOTORS 9

Fundamentals of permanent magnets – demagnetization curve – Comparison of conventional and brushless dc machine – Position detection using hall element – Basic three phase bipolar driven motor – Multi phase brushless motor – Square wave permanent magnet brushless motor – Torque and emf equations – Torque- speed characteristics – Control methods.

UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS 9

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes.

UNIT V CONTROLLER FOR SPECIAL MACHINES 9

Stepper motor: drive systems and circuit for open loop control – Closed loop operation system using microprocessor, SRM: Microcontroller based control, BLDC: Six step commutations for PM Brushless dc motor and sinusoidal commutation drive.

TOTAL: 45

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LIST OF EXPERIMENTS

1. Speed control of Converter fed DC motor.
2. Speed control of Chopper fed DC motor.
3. V/f control of three-phase induction motor.
4. Micro controller based speed control of Stepper motor
5. Speed control of BLDC motor.
6. DSP based speed control of SRM motor.
7. Design of switched mode power supplies.
8. Design of UPS.
9. Simulation of Four quadrant operation of three-phase induction motor.
10. Voltage Regulation of three-phase Synchronous Generator.
11. Study of power quality analyzer.

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Miller, T.J.E.	Brushless permanent magnet and reluctance motor drives	Clarendon Press, Oxford	1989
2.	Kenjo, T	Stepping motors and their microprocessor control	Clarendon Press, Oxford	1989
3.	Naser A and Boldea L	Linear Electric Motors: Theory Design and Practical Applications	Prentice Hall Inc., New Jersey	1987

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Kenjo, T and Naganori, S	Permanent Magnet and brushless DC motors	Clarendon Press, Oxford	1989
2.	Kenjo, T	Power Electronics for the microprocessor	Oxford University Press	1994

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1. https://www.youtube.com/watch?v=Qy6mA4TEpyI
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3. https://www.youtube.com/watch?v=Qy6mA4TEpyI
4. https://www.youtube.com/watch?v=b24jORRoxEc
5. https://www.youtube.com/watch?v=VoN0e3n6EGA

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16PEB08 POWER QUALITY

COURSE OBJECTIVES

- The concept of the Power Quality Issues.
- The concept of the Single phase linear and nonlinear loads.
- The concept of load compensation and voltage regulation using DVR and analysis of classical load balancing problem.
- The concept of instantaneous PQ theory and control of DSTATCOM.
- To analysis of series compensation and power distribution.

COURSE OUTCOMES

- Explain the various power quality issues.
- Elucidate the concept of power and power factor in single phase and three phase systems supplying non-linear loads.
- Explicate the conventional compensation techniques used for power factor correction and load voltage regulation.
- Clarify the active compensation techniques used for power factor correction and load voltage regulation.
- Analysis of series compensation and power distribution.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB08.CO1	X	-	X	X	X	X	-	-	-	X	X	X	X	X	-
16PEB08.CO2	X	X	-	X	X	X	-	-	X	X	-	X	X	-	-
16PEB08.CO3	X	X	X	X	X	X	-	-	X	X	X	X	X	X	-
16PEB08.CO4	X	X	X	X	X	X	-	-	X	X	X	X	X	X	-
16PEB08.CO5	X	X	X	X	X	X	-	-	X	X	X	X	X	X	-

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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, Nonlinear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage -- Effect of harmonics in power system equipment - Power quality standards.

UNIT II ANALYSIS OF LINEAR AND NON-LINEAR SYSTEMS 9

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

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 real and reactive powers – Extraction of fundamental sequence component. Voltage Sag Lost Energy Index (VSLEI) - Analysis of voltage flicker, Reduced duration and customer impact of outages.

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.

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UNIT V SERIES COMPENSATION AND POWER DISTRIBUTION SYSTEM 9

Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – Voltage Restoration – Series Active Filter – Unified power quality conditioner Utility-Customer interface –Harmonic filters: passive, Active and hybrid filters – Custom power devices: Network reconfiguring Devices, protecting sensitive loads using DVR, UPQC – Control strategies, Synchronous detection method – Custom power park – Status of application of custom power devices.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Arindam Ghosh	Power Quality Enhancement Using Custom Power Devices	Springer International Edition	2002
2.	G.T.Heydt	Electric Power Quality, 2nd edition	Stars in a Circle Publications	1994
3.	Roger.C.Dugan, Mark.F.McGranaghan, Surya Santoso, H.Wayne Beaty	Electrical Power Systems Quality	McGraw Hill	2004

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Derek A. Paice	Power electronic converter harmonics: Multi pulse Method for Clean Power	Wiley-IEEE Press	1999
2.	Jos Arrillaga, Neville R. Watson	Power system harmonics, 2nd Edition	Wiley	2003

WEB URLs

1. https://www.youtube.com/watch?v=YutEqt6IFCk
2. https://www.youtube.com/watch?v=3fYViOgv0NA
3. https://www.youtube.com/watch?v=dPFKcUxbNuQ
4. https://www.youtube.com/watch?v=tXihsQayiSM
5. https://www.youtube.com/watch?v=qe3hK2M5Te8

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16PEB09 ADVANCED DIGITAL SIGNAL PROCESSING

COURSE OBJECTIVES

- To expose the students to the fundamentals of digital signal processing in frequency domain& its application.
- To teach the fundamentals of digital signal processing in time-frequency domain& its application.
- To compare Architectures & features of Programmable DSP processors.
- To discuss on Application development with commercial family of DS Processors.
- To design & develop logical functions of DSP Processors with Re- Programmable logics &Devices.

COURSE OUTCOMES

Upon completion of the course, students will be able to,

- Comprehend the DFTs and FFTs.
- Design and Analyze the digital filters.
- Comprehend the Finite word length effects in Fixed point DSP Systems.
- Acquire the basics of multi rate digital signal processing.
- Analyze the power spectrum estimation (4 or 5 methods).

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB09.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PEB09.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEB09.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEB09.CO4	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEB09.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

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UNIT I INTRODUCTION TO DIGITAL SIGNAL PROCESSING 9

Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Decimation and Interpolation, Digital Filters, FIR Filters, IIR Filters.

UNIT II WAVELET TRANSFORM 9

Principle of operation of half and full bridge inverters –Three phase inverters with 180 degree and 120 degree conduction mode with star and delta connected loads – Performance parameters–Voltage control of single phase and three phase inverters using various PWM techniques –Various harmonic elimination techniques

UNIT III ARCHITECTURES OF COMMERCIAL DIGITAL SIGNAL PROCESSORS 9

Introduction, categorization of DSP Processors, Fixed Point (Black fin), Floating Point (SHARC), TI TMS 320c6xxx & OMAP processors TMS320C54X & 54xx on Basic Architecture – comparison : of functional variations of Computational building blocks, MAC, Bus Architecture and memory, Data Addressing, Parallelism and pipelining, Parallel I/O interface, Memory Interface, Interrupt, DMA (one example Architecture in each of these case studies).

UNIT IV INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS 9

Introduction, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O Direct Memory Access (DMA) -Introduction, Design of Decimation and Interpolation Filter, FFT Algorithm.

UNIT V VLSI IMPLEMENTATION 9

Low power Design - need for Low power VLSI chips - Basics of DSP system architecture design using VHDL programming, Mapping of DSP algorithm onto hardware, Realization of MAC & Filter structure.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John G.Proaks, Dimitris	Digital Signal Processing	Pearson Education	2002
	G.Manolakis			
2.	Avatar Sing, S. Srinivasan	Digital Signal Processing-Implementation using DSP Microprocessors with Examples from TMS320C54xx	Thomson India	2004
3.	Lars Wanhammer	DSP Integrated Circuits	Academic press	1999

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Lyla B Das	Embedded Systems-An Integrated Approach	Pearson Education	2013
2.	Ashok Ambardar	Digital Signal Processing: A Modern Introduction	Thomson India edition	2007
3.	Raghuveer M.Rao and Ajit S.Bapardikar	Wavelet transforms-Introduction to theory and applications	Pearson Education	2000

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2. https://www.youtube.com/watch?v=dSi9mLaa-WE
3. http://www.powershow.com/view1/219234-ZDc1Z/DSP_ Processor_ Architecture_ power point_ ppt _ presentation
4. http://www.powershow.com/view/132146-YjY5Z/Interfacing_ Processors_and_ Peripherals_ powerpoint_ ppt_presentation
5. https://www.youtube.com/watch?v=adtiViJNsmY

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16PEB10 EMERGING TRENDS IN POWER CONVERSION TECHNOLOGY

COURSE OBJECTIVES

- To study the various switching techniques to reduce the harmonics on output of power converters.
- To study the recent advancements in power converters.
- To know the digital switching techniques in dc-dc converters
- To know multilevel matrix converter and its applications
- To know the harmonic mitigations methods.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- An ability to understand the PWM techniques.
- An ability to understand voltage lift techniques in of dc-dc converters.
- An ability to understand the FFT analysis of multilevel inverters
- An ability to know about multilevel matrix converter and source matrix converter.
- An ability to know the harmonic mitigations methods.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB10.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB10.CO2	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB10.CO3	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB10.CO4	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB10.CO5	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-

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UNIT I SWITCHING TECHNIQUES 9

Gating signals – PWM techniques – Types – SPWM, SVPWM and SVM – choice of carrier frequency in SPWM – switch realization – switching losses – efficiency Vs switching frequency – applications – EMI and EMC considerations.

UNIT II DC – DC CONVERTERS 9

DC – DC converter – hard and soft switching concepts – digital switching techniques - Luo converter - principle of operation – voltage lift techniques - MPPT algorithms – sliding mode control - applications – photovoltaic systems – hybrid vehicles.

UNIT III ADVANCES IN INVERTERS 9

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters – Hybrid multi-level inverter- FFT analysis- Comparison of multilevel inverters - Applications of multilevel inverter - Principle of operation of impedance source inverter- Shoot thro zero state – Application – UPS – Adjustable speed drives.

UNIT IV MATRIX CONVERTER 9

Single phase and three phase – direct indirect – sparse and very sparse – multilevel matrix converter – Z source matrix converter – applications – wind mills – Adjustable speed drives industrial applications - Hybrid vehicles. .

UNIT V HARMONIC MITIGATIONS 9

Effects of harmonics – harmonics eliminations – selective harmonic elimination – selective sine PWM carrier elimination – Power Factor controlling – active power factor controlling – hysteresis control – voltage feedback control - current feedback control.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ned Mohan, Undeland and Robbin	Power Electronics: Converters, Application and Design	John Wiley and Sons Inc	2002
2.	Kolar, J.W. Schafmeister, F. Round, S.D. Ertl, H. ETH Zurich and Zurich	Novel Three-Phase AC–AC Sparse Matrix Converters	IEEE Transaction on Power Electronics	2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	D.M. Bellur, M.K. Kazimierczuk and O.H. Dayton	DC-DC Converters for Electric Vehicle Applications	Conference on Electrical Insulation and Electrical Manufacturing Expo, 22-24	2007
2.	S. Masoud Barakati	Applications of Matrix Converters for Wind Turbine Systems	VDM Verlag Publishers	2008

WEB URLs

1. http://www.powershow.com/view/3db4f8-NjQ3O/ Electrical_ Power_Generation _ Transmission Storage_and_Utilization_powerpoint_ppt_presentation
2. https://www.youtube.com/watch?v=OxIQhyAn9JE
3. https://www.youtube.com/watch?v=1Auay7ja2oY
4. https://www.youtube.com/watch?v=epVmeN3tkB4
5. https://www.youtube.com/watch?v=ukWj3nHn4eQ

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16PEB11 SMPS AND UPS

COURSE OBJECTIVES

- To understand various types of DC-DC converters
- To understand characteristics of SMPS
- To understand the concept of resonant converters
- To understand the concept of DC-AC converters
- To understand the concept of power conditioners, UPS & filters

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Understand various types of DC-DC converters
- Understand characteristics of SMPS
- Understand the concept of resonant converters
- Understand the concept of DC-AC converters
- Understand the concept of power conditioners, UPS & filters

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB11.CO1	X	X	-	-	X	-	-	-	-	-	-	-	X	X	X
16PEB11.CO2	X	X	-	-	-	-	-	-	-	-	-	X	X	X	-
16PEB11.CO3	X	X	-	-	X	-	-	-	X	-	-	-	X	X	X
16PEB11.CO4	X	X	-	-	-	-	-	-	-	-	-	X	X	X	-
16PEB11.CO5	X	X	X	-	-	-	-	-	-	-	-	-	X	X	-

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UNIT I DC-DC CONVERTERS 9

Principles of step-down and step-up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT II SWITCHING MODE POWER CONVERTERS 9

Analysis and state space modeling of fly back, 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 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.

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.H. Rashid	Power Electronics handbook	Elsevier Publication	2001
2.	Kjeld Thorborg	Power Electronics – In theory and Practice, First Indian Edition	Overseas Press	2005
3.	Hilip T Krein	Elements of Power Electronics	Oxford University Press	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Ned Mohan, Tore.M.Undeland, William.P.Robbins	Power Electronics converters, Applications and design, Third Edition	John Wiley and Sons	2006
2.	M.H. Rashid	Power Electronics circuits, devices and applications, Third edition	Prentice Hall of India New Delhi	2007

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2. http://freevideolectures.com/Course/3208/Switched-Mode-Power-Conversion
3. https://www.youtube.com/watch?v=JRgl-N_x1u4
4. https://www.youtube.com/watch?v=MWW2A9FBeIs
5. http://www.abb.com/?returnurl=/product/us/9aac167825.aspx

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16PEB12 COMPUTER AIDED DESIGN OF POWER ELECTRONIC CIRCUITS

COURSE OBJECTIVES

- To provide knowledge about the simulation of power electronic devices and circuits.
- To acquire knowledge about advanced techniques in simulation
- To analyze and comprehend the characteristics various power electronic devices.
- To acquire about various methods for simulation of power electronic circuits.
- To give exposure to various power electronic circuit and devices.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Comprehend about the simulation of power electronic devices and circuits.
- Understand the concept of advanced techniques in simulation.
- Compute the characteristics various power electronic devices like BJT, FET and MOSFET.
- Understand the concept Monte Carlo and Fourier analysis.
- Understand the various power electronic circuit and devices.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEB12.CO1	X	X	X	-	-	-	-	-	-	X	-	X	X	-	-
16PEB12.CO2	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB12.CO3	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB12.CO4	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-
16PEB12.CO5	X	X	X	-	-	X	-	-	X	X	-	X	X	-	-

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UNIT I INTRODUCTION 9

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

UNIT II ADVANCED TECHNIQUES IN SIMULATION 9

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

UNIT III MODELING OF POWER ELCTRONIC DEVICES 9

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

UNIT IV SIMULATION OF CIRCUITS 9

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

UNIT V CASE STUDIES 9

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

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rashid, M	Simulation of Power Electronic Circuits using PSPICE	PHI	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rajagopalan, V.	Computer Aided Analysis of Power Electronic systems	Marcell – Dekker Inc.	1987
2.	John Keown	Microsim, Pspice and circuit analysis	Prentice Hall Inc.	1998

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3. https://www.youtube.com/watch?v=cMFS1U3hno8
4. https:// https://www.youtube.com/watch?v=x2RUogerZck
5. www.youtube.com/watch?v=NoGYYsOkOA8

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16PEC01 LINEAR AND NON LINEAR SYSTEMS THEORY

COURSE OBJECTIVES

- To educate on modeling and representing systems in state variable form.
- To educate on solving linear and non-linear state equations.
- To illustrate the role of controllability and observability.
- To educate on stability analysis of systems using Lyapunov"s theory.
- To educate on modal concepts and design of state and output feedback controllers and estimators.\

COURSE OUTCOMES

Upon completion of the course, students will be able to,

- Identify the stability of the given linear system & Design pole placement controller and/or observer for the given system to achieve desired specifications.
- Identify the existence of limit cycle(s) for the given nonlinear system using describing function method.
- Explain the concept of Lyapunov stability.
- Explain optimal state regulator and stochastic optimal regulator.
- Explain the concept of adaptive control and fuzzy logic.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC01.CO1	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEC01.CO2	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEC01.CO3	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEC01.CO4	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-
16PEC01.CO5	X	X	X	-	-	-	-	-	X	X	-	X	X	-	-

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UNIT I LINEAR SYSTEMS 9

Concepts of state, state variables and state model - State model for linear time invariant continuous systems. Diagonalization – Solution of state equations – Concepts of Controllability and Observability- Pole placement by state feedback – Observer systems.

UNIT II NON-LINEAR SYSTEMS 9

Types of non-linearity – Typical examples – Phase plane analysis – Singular points – Limit cycles – Construction of phase trajectories – Describing function method – Derivation of describing functions.

UNIT III LIAPUNOV STABILITY 9

Liapunov stability analysis – Stability in the sense of Liapunov – Definiteness of scalar Functions – Quadratic forms – Second method of Liapunov – Liapunov stability analysis of linear time invariant systems and nonlinear systems.

UNIT IV OPTIMAL CONTROL SYSTEMS 9

Parameter Optimization: Servomechanisms – Optimal Control Problems: Transfer function Approach – State variable approach – the state regulator problem – The Infinite-time regulator problem – Output regulator and the tracking Problems – Parameter Optimization: Regulators.

UNIT V ADVANCED CONTROL SYSTEMS 9

Adaptive Control: Model-Reference Adaptive Control fundamental concepts – Self tuning control – Robust Control: Parameter perturbations - Design of robust control system – PID controllers – Fuzzy Logic Control –Neural Network Controller.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M. Gopal	Modern Control System Theory	New Age International	2005
2.	K. Ogatta	Modern Control Engineering	PHI	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John S. Bay	Fundamentals of Linear State Space Systems	McGraw-Hill	1999
2.	D.Roy Choudhury	Modern Control Systems	New Age International	2005
3.	John J.D.Azzo, C.H.Houpis and S.N.Sheldon	Linear Control System Analysis and Design with MATLAB	Taylor Francis	2003

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1. https://en.wikipedia.org/wiki/Linear_system
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3. nptel.ac.in/courses/108105019/
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5. nptel.ac.in/courses/108103007/

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16PEC02 MICROCONTROLLER BASED SYSTEM DESIGN

COURSE OBJECTIVES

- To expose the students to the fundamentals of microcontroller based system design.
- To teach I/O and RTOS role on microcontroller.
- To impart knowledge on PIC Microcontroller based system design.
- To introduce Microchip PIC 8 bit peripheral system Design
- To give case study experiences for microcontroller based applications.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Describe the fundamentals of microcontroller based system design.
- Depict the basics of I/O and RTOS role in microcontroller.
- Explain the concept of PIC Microcontroller based system design.
- Express the case study experiences for microcontroller based applications.
- Give case study experiences for microcontroller based applications.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC02.CO1	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEC02.CO2	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEC02.CO3	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEC02.CO4	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-
16PEC02.CO5	X	X	X	X	X	-	-	-	X	X	X	X	-	X	-

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UNIT I 8051 ARCHITECTURE 9

Hardware Architecture ,pin and signal diagram–Functional Building Blocks of Controller–Memory organization– I/O ports and data transfer concepts– Timing Diagram – Interrupts

UNIT II 8051 MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises- key board and display interface – Closed loop control of servo motor- stepper motor control – Washing Machine Control.

UNIT III PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller–PIC16C6x and PIC16C7x Architecture – PIC16cxx – Pipelining- Program Memory considerations–Register File Structure-Instruction Set-Addressing modes – Simple Operations.

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER 9

Timers – Programming Timers 0 and 1, PIC Microcontroller Interrupts, I2C bus for peripheral chip access- Serial EEPROM-Analog to Digital converter- UART - ADC, DAC and Sensor Interfacing.

UNIT V ARM PROCESSOR AND ATMEGA CONTROLLER 9

ARM Architecture - ARM programmer's model - ARM Development tools - Memory Hierarchy – 3 Stage ARM Pipeline Organization- 5 Stage ARM Pipeline organization - ATMEGA architecture - Pin Configurations - Arduino Technology and Software - Simple programmes.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey	PIC Microcontroller and Embedded Systems using Assembly and C for PIC18	Pearson Education	2008
2.	John Iovine	PIC Microcontroller Project Book	McGraw Hill	2000
3.	Myke Predko	Programming and customizing the 8051 microcontroller	Tata McGraw Hill	2001

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay	The 8051 Microcontroller and Embedded Systems	Prentice Hall	2005
2.	I Scott Mackenzie and Raphael C.W. Phan	The Micro controller	Pearson, Fourth edition	2012

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3. https://www.youtube.com/watch?v=vnE8pPqUsxw
4. https://www.youtube.com/watch?v=qTZaE2lcYTo
5. https://www.youtube.com/watch?v=L-wovGBOUrw

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16PEC03 ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING

COURSE OBJECTIVES

- To refresh the fundamentals of Electromagnetic Field Theory.
- To provide foundation in formulation and computation of Electromagnetic Fields using analytical and numerical methods.
- To impart in-depth knowledge on Finite Element Method in solving Electromagnetic field problems.
- To introduce the concept of mathematical modeling and design of electrical Apparatus
- To design the electromagnetic field models

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Describe the basics of Electromagnetic Field theory.
- Understand the basic solution methods for field equations
- Describe the finite element method
- Compute the basic quantities using FEM packages
- Design various electrical apparatus

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC03.CO1	X	-	X	-	-	X	X	-	-	X	-	X	-	-	-
16PEC03.CO2	X	X	-	-	X	X	-	-	-	X	-	X	X	-	X
16PEC03.CO3	X	X	X	-	X	X	X	-	X	X	-	X	X	-	X
16PEC03.CO4	X	X	X	-	X	X	X	-	X	X	-	X	X	-	X
16PEC03.CO5	X	X	-	-	X	X	-	-	-	X	-	X	-	-	X

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UNIT I INTRODUCTION 9

Review of basic field theory – Maxwell's equations – Constitutive relationships and Continuity equations – Laplace, Poisson and Helmholtz equation – principle of energy conversion – force/torque calculation.

UNIT II BASIC SOLUTION METHODS FOR FIELD EQUATIONS 9

Limitations of the conventional design procedure, need for the field analysis based design, problem definition, boundary conditions, solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

UNIT III FORMULATION OF FINITE ELEMENT METHOD (FEM) 9

Variational Formulation – Energy minimization – Discretization – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problems.

UNIT IV COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES 9

Basic quantities – Energy stored in Electric Field – Capacitance – Magnetic Field – Linked Flux – Inductance – Force – Torque – Skin effect – Resistance.

UNIT V DESIGN APPLICATIONS 9

Design of Insulators – Cylindrical magnetic actuators – Transformers – Rotating machines.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Matthew. N.O. Sadiku	Elements of Electromagnetics	Oxford University Press	2007
2.	K.J.Binns, P.J.Lawrenson, C.W Trowbridge	The analytical and numerical solution of Electric and magnetic fields	John Wiley & Sons	1997
3.	Nicola Biyanchi	Electrical Machine analysis using Finite Elements	CRC Publishers	2005

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Nathan Ida, Joao P.A.Bastos	Electromagnetics and calculation of fields,	Springer- Verlage	1992
2.	S.J Salon	Finite Element Analysis of Electrical Machines	Kluwer Academic Publishers	1995

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2. https://www.youtube.com/watch?v=RGtCw5E7gBc
3. https://www.youtube.com/watch?v=tYbEE4Kc5QU
4. https://www.youtube.com/watch?v=sp_stBy-AUE
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16PEC04 FLEXIBLE AC TRANSMISSION SYSTEMS

COURSE OBJECTIVES

- To emphasis the need for FACTS controllers.
- To learn the characteristics, applications and modeling of series and shunt
- FACTS controllers.
- To analyze the interaction of different FACTS controller and perform control coordination
- To model Facts devices

COURSE OUTCOMES

Upon completion of the course, students will be able to,

- Understand the basic principles, characteristics of different types of FACTS controllers.
- Compare the performance of various FACTS controllers.
- Model FACTS controller for power flow and stability applications.
- Select a suitable FACTS controller for a particular application
- Model Facts devices

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC04.CO1	X	-	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC04.CO2	X	X	-	-	-	X	-	-	X	X	-	X	X	-	-
16PEC04.CO3	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-
16PEC04.CO4	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-
16PEC04.CO5	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-

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UNIT I INTRODUCTION 9

Reactive power control in electrical power transmission lines -Uncompensated transmission line – Fixed series and shunt compensation – Basic types of FACTS controllers – Brief description and definitions of FACTS controllers.

UNIT II STATIC SHUNT COMPENSATORS 9

Objective of Shunt Compensation - Variable Impedance Type Static VAR Generators – Switching Converter Type VAR Generators - Basic operating principle and V-I Characteristics and Control Schemes – Comparison between thyristor based VSC and STATCOM. Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of Power system damping – Prevention of voltage instability.

UNIT III STATIC SERIES COMPENSATORS 9

Objective of Series Compensation - Variable Impedance Type Static Series Compensator - TCSC,TSSC – Switching Converter Type Series Converters - Operation, Characteristics and Control Schemes – Modeling of TCSC – Variable reactance model- Applications: Improvement of the system stability limit- Enhancement of system damping – SSR Mitigation

UNIT IV PHASE ANGLE REGULATORS AND UPFC 9

Power Flow Control using TCPAR – UPFC – Operation – Transmission Control Capabilities – Real and Reactive Power Control Scheme – Applications-UPQC & IPFC.

UNIT V MODELING OF FACTS CONTROLLERS 9

Modeling of Shunt and Series Controllers for Power Flow and Transient stability. Modeling of UPFC.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	K.R.Padiyar	FACTS Controllers in Power Transmission and Distribution	New Age International (P)Ltd. ,Publishers New Delhi	Reprint 2008
2.	MohanMathur,R. , Rajiv.K.Varma.	Thyristor–Based Facts Controllers for Electrical Transmission Systems	IEEE press and John Wiley & Sons, Inc	2009

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.T.John	Flexible AC Transmission System	Institution of Electrical and Electronic Engineers (IEEE)	1999
2.	Narain G.Hingorani, Laszio. Gyugyl	Understanding FACTS Concepts and Technology of Flexible AC Transmission System	Standard Publishers, Delhi	2001
3.	V. K.Sood	HVDC and FACTS controllers –Applications of Static Converters in Power System	Kluwer Academic Publishers	2004

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3. https://www.youtube.com/watch?v=qe3hK2M5Te8
4. https://www.youtube.com/watch?v=ejYAMf1gCJY
5. http://www.powershow.com/view/ccdd4YjQ2M/Flexible_AC_Transmission_Systems_Placement_Control_and_Interaction_powerpoint_ppt_presentation

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16PEC05 VLSI ARCHITECTURE AND DESIGN METHODOLOGIES

COURSE OBJECTIVES

- To give an insight to the students about the significance of CMOS technology and fabrication process.
- To teach the importance and architectural features of programmable logic devices.
- To introduce the ASIC construction and design algorithms
- To teach the basic analog VLSI design techniques.
- To study the Logic synthesis and simulation of digital system with Verilog HDL

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Describe the characteristics of CMOS circuit construction and the comparison between different state-of-the-art CMOS technologies and processes.
- Analyze the different types of ASICs design and Logic cell architecture and interconnects.
- Analyze and design small scale combinational logic circuits using HDLs.
- Illustrate the importance of testing and its types in VLSI circuits
- Study the Logic synthesis and simulation of digital system with Verilog HDL

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC05.CO1	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-
16PEC05.CO2	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-
16PEC05.CO3	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-
16PEC05.CO4	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-
16PEC05.CO5	X	X	X	X	-	X	-	-	-	X	-	X	X	X	-

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UNIT I CMOS DESIGN 9

Overview of digital VLSI design Methodologies- Logic design with CMOS-transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits- Layout diagram, Stick diagram-IC fabrications – Trends in IC technology.

UNIT II PROGRAMABLE LOGIC DEVICES 9

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology – Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx-XC9500,Cool Runner - XC-4000,XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 10K-Stratix.

UNIT III BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING 9

System partition – FPGA partitioning – Partitioning methods- floor planning – placement-physical design flow – global routing – detailed routing – special routing- circuit extraction – DRC.

UNIT IV ANALOG VLSI DESIGN 9

Introduction to analog VLSI- Design of CMOS 2stage-3 stage Op-Amp –High Speed and High frequency op-amps-Super MOS-Analog primitive cells-realization of neural networks.

UNIT V LOGIC SYNTHESIS AND SIMULATION 9

Overview of digital design with Verilog HDL, hierarchical modelling concepts, modules and port definitions, gate level modelling, data flow modelling, behavioral modelling, task & functions, Verilog and logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead

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adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.J.S Smith	Application Specific integrated circuits	Addition Wesley LongmanInc	1997
2.	Kamran Eshraghian, Douglas A.pucknell and Sholeh Eshraghian	Essentials of VLSI circuits and system	Prentice Hall India	2005

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Wayne Wolf	Modern VLSI design	Prentice Hall India	2006
2.	Mohamed Ismail, Terri Fiez	Analog VLSI Signal and information Processing	McGraw Hill International Editions	2008
3.	Samir Palnitkar	Veri Log HDL, A Design guide to Digital and Synthesis	2nd Ed, Pearson	2005

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1. http://web.ewu.edu/groups/technology/Claudio/ee430/Lectures/L1-print.pdf
2. https://www.youtube.com/watch?v=PkFX7NjgEdA
3. https://www.udemy.com/vlsi-academy/
4. https://www.youtube.com/watch?v=Q3WYZF5wzgU
5. https://www.youtube.com/watch?v=hJArf9XtkC4

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16PEC06 ENERGY MANAGEMENT AND AUDITING

COURSE OBJECTIVES

- To study the concepts behind economic analysis and Load management.
- To emphasize the energy management on various electrical equipment and metering.
- To illustrate the concept of lighting systems and cogeneration.
- To understand the metering for energy management
- To explain the lightning system and cogeneration.

COURSE OUTCOMES

Upon completion of the course, students will be able to

- Learn the concepts of economic analysis and load management.
- Learn the energy management on various electrical equipment and metering.
- Gain knowledge regarding the lighting systems and cogeneration.
- Understand the metering for energy management
- Explain the lightning system and cogeneration.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC06.CO1	-	X	X	-	-	X	X	-	-	X	-	X	-	-	-
16PEC06.CO2	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PEC06.CO3	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PEC06.CO4	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
16PEC06.CO5	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-

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3	0	0	3

UNIT I INTRODUCTION 9

Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting- energy audit process

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT 9

Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements-Metering techniques and practical examples.

UNIT V LIGHTING SYSTEMS & COGENERATION 9

Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Reay D.A	Industrial Energy Conservation	Pergamon Press	1977
2.	Amit K. Tyagi	Handbook on Energy Audits and Management	-	2006
3.	-	IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities.	IEEE, 196	-

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Barney L. Capehart, Wayne C. Turner, and William J. Kennedy	Guide to Energy Management	Fifth Edition, The Fairmont Press	2006
2.	Eastop T.D & Croft D.R	Energy Efficiency for Engineers and Technologists	Logman Scientific & Technical, ISBN-0-582-03184	1990

WEB URLs

1. https://www.youtube.com/watch?v=HSuTnumO44k
2. https://www.youtube.com/watch?v=CQMBtZFE9PY
3. http://w3.siemens.com/mcms/industrial-controls/en/control-devices-monitoring/motor-management /pages/default.aspx
4. https://www.youtube.com/watch?v=XKh2NG3-5so
5. https://www.youtube.com/watch?v=N27VtJBKzXI

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16PEC07 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

COURSE OBJECTIVES

- To impart knowledge on operation, Modeling and control of HVDC link.
- To perform steady state analysis of AC/DC system.
- To expose various HVDC simulators.
- Recognize the best strategies for stakeholder engagement, communication, and
- Outreach programs for HVDC projects.

COURSE OUTCOMES

- Identify driving factors behind the resurgence of HVDC.
- Examine how an actual utility operates its existing, successful HVDC system.
- Review the impact FERC rulemaking has on HVDC transmission projects.
- Examine the policy and regulatory attitudes toward HVDC.
- Discuss replacing existing AC transmission with a new DC system and the associated benefits of making the switch.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC07.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PEC07.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC07.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC07.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC07.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

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UNIT I GENERAL ASPECTS 9

Historical development of HVAC and DC links – kinds of DC links-HVDC projects in India and abroad –advantages and disadvantages of HVDC transmission - Applications of DC transmission – economic factors – development of power devices for HVDC transmission – thyristors – light activated thyristors – MOS controlled thyristors- Switching and steady state characteristics–Cooling of Thyristors Problem.

UNIT II THYRISTOR CONVERTERS 9

Three phase fully controlled thyristor bridge converters – operation as rectifiers and line commutated inverters – converter equivalent circuits – parameters and characteristics of rectifiers and inverters – series and parallel arrangement of thyristors – multibridge converters

UNIT III CONTROL OF CONVERTERS AND REACTIVE POWER CONTROL 9

Gate control – basic means of control and modes of operation – power reversal – desired features of control – control characteristics – constant current control – constant extinction angle control – stability of control – tap changer control – power control and current limits. Reactive Power Requirements – Reactive Power Control during Steady State and Transients

UNIT IV PROTECTION OF HVDC SYSTEMS, HARMONICS, FILTERS AND GROUND RETURN 9

Basics of protection of HVDC systems – DC reactors – voltage and current oscillations – DC line oscillations – clearing line faults and re-energizing the line – circuit breakers – over voltage protection - Characteristics and uncharacteristic harmonics – troubles caused by harmonics – means of reducing harmonics — harmonic filters – Corona and Radio interference- ground return and ground Electrodes.

UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction – System Simulation: Philosophy and Tools – HVDC System Simulation – Modeling of HVDC Systems for Digital Dynamic Simulation – Digital Dynamic Simulation of Converters and DC Systems.

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TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	P.Kundur	Power System Stability and Control	McGraw-Hill	1993
2.	K.R.Padiyar	HVDC Power Transmission Systems	New Age International (P) Ltd	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	V.K.Sood	HVDC and FACTS controllers – Applications of Static Converters in Power System	Kluwer Academic Publishers	2004
2.	J.Arrillaga	High Voltage Direct Current Transmission	Peter Pregrinus	1983
3.	Erich Uhlmann	Power Transmission by Direct Current	BS Publications	2004

WEB URLs

1. http://www.energy.siemens.com/hq/en/power-transmission/hvdc/
2. http://freevideolectures.com/Course/3076/High-Voltage-DC-Transmission
3. https://www.youtube.com/watch?v=e7qpW8TgMMU
4. https://www.youtube.com/watch?v=fBm1dr_gRBk
5. https://www.youtube.com/watch?v=mo2BybIuiUE

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16PEC08 APPLICATION OF MEMS TECHNOLOGY

COURSE OBJECTIVES

- To teach the students properties of materials, microstructure and fabrication method.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling.
- To teach the fundamentals of piezoelectric sensors and actuators
- To give exposure to different MEMS and NEMS devices.

COURSE OUTCOMES

- Understand basics of micro fabrication.
- Understand material properties important for MEMS system performance
- Understand the design process and validation for MEMS devices and systems,
- Teach the fundamentals of piezoelectric sensors and actuators
- Give exposure to different MEMS and NEMS devices.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC08.CO1	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PEC08.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PEC08.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PEC08.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PEC08.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X

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UNIT I MEMS: MICROFABRICATION, MATERIALS AND ELECTRO MECHANICAL CONEPTS 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-tensional 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

Piezo resistive sensors – Magnetic actuation- Micro fluidics applications- Medical applications - Optical MEMS - NEMS Devices.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chang Liu Robbin	Foundations of MEMS	Pearson International Edition	2006
2.	Marc Madou	Fundamentals of micro fabrication	CRC Press	1997
3.	Boston	Micro machined Transducers Source book	WCB McGraw Hill	1998

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.H.Bao	Micromechanical transducers: Pressure sensors, accelerometers and gyroscopes	Elsevier , New york	2000
2.	P.Rai Choudry	MEMS and MOEMS Technology and Applications	PHI	2012
3.	Stephen D.Senturia	Microsystem Design	Springer International Edition	2011

WEB URLs

1. https://www.powershow.com/view/146290-NzkzM/MEMS_Fabrication_powerpoint_ppt_presentation
2. https://www.youtube.com/watch?v=jMb4U90MZWo
3. https://www.youtube.com/watch?v=cm7X5OJMOJA
4. https://www.youtube.com/watch?v=sPxnpYHQyFg
5. https://www.hbm.com/en/4180/video-connection-a-force-sensor-to-a-daq/

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16PEC09 SOLAR AND ENERGY STORAGE SYSTEMS

COURSE OBJECTIVES

- To demonstrate the knowledge of the physics of solar power generation.
- To learning advanced techniques of grid connectivity
- To analyze optimization non-conventional sourcespower.
- To explain simulation and modeling of solar photovoltaic systems.
- To experiment on solar cell andsolar panels with its interfacing circuits.

COURSE OUTCOMES

- Demonstrate the knowledge of the physics of solar power generation.
- Learning advanced techniques of grid connectivity
- Analyze optimization non-conventional sourcespower.
- Explain simulation and modeling of solar photovoltaic systems.
- Experiment on solar cell andsolar panels with its interfacing circuits.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC09.CO1	X	-	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC09.CO2	X	X	-	-	-	X	-	-	X	X	-	X	X	X	-
16PEC09.CO3	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-
16PEC09.CO4	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-
16PEC09.CO5	X	X	X	X	-	X	-	-	X	X	X	X	X	X	-

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UNIT I INTRODUCTION 9

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

UNIT II STAND ALONE PV SYSTEM 9

Solar modules – storage systems – power conditioning and regulation - protection – standalone PV systems design – sizing

UNIT III GRID CONNECTED PV SYSTEMS 9

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

UNIT IV ENERGY STORAGE SYSTEMS 9

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

UNIT V APPLICATIONS 9

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

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
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 Photovoltaic	Earth scan	2006
3.	S.P. Sukhatme	Solar Energy	Tata McGraw Hill	1987

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Frank S. Barnes & Jonah G. Levine	Large Energy storage Systems Handbook,	CRC Press	2011
2.	McNeils, Frenkel, Desai	Solar & Wind Energy Technologies	Wiley Eastern	1990

WEB URLs

1. https://www.youtube.com/watch?v=3HppXB9WmuQ
2. https://www.youtube.com/watch?v=v9E8vIW3_n0
3. https://www.youtube.com/watch?v=dTm5L07toq0
4. https://www.youtube.com/watch?v=lQTDeszh-I8
5. https://www.youtube.com/watch?v=ZxNGOaAWD9E

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16PEC10 WIND ENERGY CONVERSION SYSTEMS

COURSE OBJECTIVES

- To express the fundamentals of wind energy and its conversion system.
- To illustrate the aerodynamics of wind turbines' energy conservation techniques.
- To design and evaluate the performance of wind turbines.
- To explain the variable speed systems
- To analyze the grid connected system.

COURSE OUTCOMES

Upon completion of the course, students will be able to,

- Express the fundamentals of wind energy and its conversion system.
- Illustrate the aerodynamics of wind turbines' energy conservation techniques.
- Design and evaluate the performance of wind turbines.
- Explain the variable speed systems
- Analyze the grid connected system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC10.CO1	-	X	X	-	-	X	X	-	-	X	-	X	-	-	-
16PEC10.CO2	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PEC10.CO3	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PEC10.CO4	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
16PEC10.CO5	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-

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UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient-Sabinin's theory-Aerodynamics 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 FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators- Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

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 GRID CONNECTED SYSTEMS 9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	L.L.Freris	Wind Energy conversion Systems	Prentice Hall	1990
2.	S.N.Bhadra, D.Kastha, S.Banerjee	Wind Electrical Systems	Oxford University Press	2010
3.	Ion Boldea	Variable speed generators	Taylor & Francis group	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	E.W.Golding	The generation of Electricity by wind power	Redwood burn Ltd., Trowbridge	1976
2.	N. Jenkins	Wind Energy Technology	John Wiley & Sons	1997
3.	S.Heir	Grid Integration of WECS	Wiley	1998

WEB URLs

1. https://www.youtube.com/watch?v=GExTwRNkQBg 2.
2. https://www.youtube.com/watch?v=GExTwRNkQBg
3. https://www.youtube.com/watch?v=ayjhL9jpFH8
4. http://freevideolectures.com/Course/2345/Industrial-Automation-and-control/31
5. https://www.youtube.com/watch?v=dTm5L07toq0

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16PEC11 NON LINEAR DYNAMICS FOR POWER ELECTRONIC CIRCUITS

COURSE OBJECTIVES

- To understand the nonlinear behavior of power electronic converters.
- To understand the techniques for investigation on nonlinear behavior of power electronic converters.
- To analyze the nonlinear phenomena in DC to DC converters.
- To analyze the nonlinear phenomena in AC and DC Drives.
- To introduce the control techniques for control of nonlinear behavior in power electronic systems.

COURSE OUTCOMES

Upon completion of the course, students will be able to,

- Investigate the non-linear behavior of power electronic converters.
- Analyze the non-linear phenomena in choppers and power electronic drives.
- Explain the new control techniques for control of chaos in power electronic systems.
- Analyze the nonlinear phenomena in AC and DC Drives.
- Introduce the control techniques for control of nonlinear behavior in power electronic Systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC11.CO1	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC11.CO2	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC11.CO3	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC11.CO4	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC11.CO5	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-

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UNIT I BASICS OF NONLINEAR DYNAMICS 9

Basics of Nonlinear Dynamics: System, state and state space model, Vector field- Modeling of Linear, nonlinear and Linearized systems, Attractors , chaos, Poincare map, Dynamics of Discrete time system, Lyapunov Exponent, Bifurcations, Bifurcations of smooth map, Bifurcations in piece wise smooth maps, border crossing and border collision bifurcation.

UNIT II TECHNIQUES FOR INVESTIGATION OF NONLINEAR PHENOMEN 9

Techniques for experimental investigation, Techniques for numerical investigation, Computation of averages under chaos, Computations of spectral peaks, Computation of the bifurcation and analyzing stability.

UNIT III NON LINEAR PHENOMENA IN DC-DC CONVERTERS 9

Border collision in the Current Mode controlled Boost Converter, Bifurcation and chaos in the Voltage controlled. Nonlinear phenomenon in the inverter under tolerance band control.

UNIT IV NON LINEAR PHENOMENA IN DRIVES 9

Nonlinear Phenomenon in Current controlled and voltage controlled DC Drives, Nonlinear Phenomenon in PMSM Drives.

UNIT V CONTROL OF CHAOS 9

Hysteresis control, Sliding mode and switching surface control, OGY Method, Pyragas method, Time Delay control. Application of the techniques to the Power electronics circuit and drives.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	George C. Vargheese, S Banerjee	Nonlinear Phenomena in Power Electronics	IEEE Press	2001
2.	Steven H Strogatz	Nonlinear Dynamics and Chaos	Westview Press	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	C.K.TSE	Complex Behaviour of Switching Power Converters	CRC Press	2003

WEB URLs

1. http://www.powershow.com/view/139b49-
2. https://www.youtube.com/watch?v=tsZITSeQFR0
3. http://www.powershow.com/view/3c8bcd
4. https://www.youtube.com/watch?v=rMu6djjIk0Q
5. https://www.youtube.com/watch?v=ZuCAil8qEx8

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16PEC12 SMART GRID

COURSE OBJECTIVES

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.
- To summarize power quality management in smart grid
- To analyze high performance computing for smart grid

COURSE OUTCOMES

- Review the distributed generation and installation Design the grid integration system with conventional and non-conventional energy sources
- Analyze the stability and power quality issues in microgrid.
- Design the dc micro grid.
- Summarize power quality management in smart grid
- Analyze high performance computing for smart grid

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC12.CO1	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC12.CO2	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC12.CO3	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC12.CO4	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PEC12.CO5	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-

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UNIT I INTRODUCTION TO SMARTGRID 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 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: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke	Smart Grid Technologies: Communication Technologies and Standards	IEEE Transactions On Industrial Informatics	2011
2.	Xi Fang, Satyajayant Misra, Guoliang Xue, and	Smart Grid – The New and Improved Power Grid: A Survey	IEEE Transaction on Smart Grids	2011
	Dejun Yang			

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Stuart Borlase	Smart Grid: Infrastructure, Technology and Solutions	CRC Press	2012
2.	Janaka Ekana yake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama	Smart Grid: Technology and Applications	Wiley	2013

WEB URLs

1. https://www.youtube.com/watch?v=aF8c0dGSDfg
2. https://www.youtube.com/watch?v=GasSFkYqfqc
3. https://www.youtube.com/watch?v=YzK5Os04d6E
4. https://www.youtube.com/watch?v=Ev8mk2J8mXU
5. https://www.smartgrid.gov/the_smart_grid/operation_centers.html

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16PEC13 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

COURSE OBJECTIVES

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyze and comprehend the various operating modes of wind electrical Generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

COURSE OUTCOMES

- Comprehend the world energy situation, to understand the bad effects of the present concentration use of energy
- Understand the concept of biomass energy systems. To be able to understand and build biomass based systems. To be able to understand the various digester operations
- Compute the solar radiation on the earth's surface
- Understand the concept of photovoltaic cells
- Understand the various types of wind turbines. To be able to model, analyze and design wind energy systems

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC13.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PEC13.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC13.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC13.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PEC13.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

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UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control Strategy, operating area.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG

UNIT III POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system: 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 ANALYSIS OF WIND AND PV SYSTEMS 9

Standalone 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 HYBRID RENEWABLE ENERGY SYSTEMS 9

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

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TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	S.N.Bhadra, D. Kastha, & S. Banerjee	Wind Electrical Systems	Oxford University Press	2009
2.	Rashid .M. H	power electronics Hand book	Academic press	2001
3.	Rai. G.D	Non-conventional energy sources	Khanna publishes	1993

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Rai. G.D	Solar energy utilization	Khanna publishes	1993
2.	Gray, L. Johnson	Wind energy system	prentice hall linc	1995
3.	Khan B.H	Non-conventional Energy sources	Tata McGraw-hill Publishing Company	1996

WEB URLs

1. https://www.youtube.com/watch?v=POmo10eNE3Y
2. http://freevideolectures.com/Course/2352/Power-System-Generation-Transmission-and-Distribution/7
3. https://www.youtube.com/watch?v=cMFS1U3hno8
4. https:// https://www.youtube.com/watch?v=x2RUogerZck
5. www.youtube.com/watch?v=NoGYYsOkOA8

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Raj kamal	Embedded Systems Architecture, Programming and Design'	Tata McGraw-Hill, second edition	2010
2.	David E.Simon	An Embedded Software Primer	Pearson Education	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	C.M. Krishna, Kang, G.Shin	Real Time Systems	McGraw Hill	1997
2.	Phillip A. Laplante	Real Time Systems Design and Analysis	An Engineer's Handbook, Second Edition, PHI India	1997

WEB URLs

1. https://www.youtube.com/watch?v=9YNmTYCvrjE
2. https://www.youtube.com/watch?v=lOg3oqOUevM
3. https://www.youtube.com/watch?v=H9fsWoDAi0U
4. https://www.youtube.com/watch?v=gYNmrye-1uY
5. https://www.youtube.com/watch?v=e0SZKZa-FLw

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Laurene V. Fausett,	Fundamentals of Neural Networks: Architectures,	Pearson Education	2010
		Algorithms And Applications.		
2.	Timothy J. Ross	Fuzzy Logic with Engineering Applications	Wiley	2006
3.	Zimmermann H.J	Fuzzy set theory and its Applications	Springer international edition	2011

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David E.Goldberg	Genetic Algorithms in Search, Optimization, and Machine Learning	Pearson Education	2009
2.	W.T.Miller, R.S.Sutton and P.J.Webrose	Real Time Systems Design and Analysis	MIT Press	1996

WEB URLs

1. https://www.youtube.com/watch?v=IS-PeWbvqbs
2. https://www.youtube.com/watch?v=fWnaiJgPIHA
3. https://www.youtube.com/watch?v=fWnaiJgPIHA
4. https://www.youtube.com/watch?v=1i8muvzZkPw
5. https://www.youtube.com/watch?v=vGhAF3Sdi8c

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16PEC15 SOFT COMPUTING TECHNIQUES

COURSE OBJECTIVES

- To expose the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To expose the ideas about genetic algorithm
- To provide adequate knowledge about of FLC and NN toolbox

COURSE OUTCOMES

- Know about soft computing techniques and their applications.
- Analyze various neural network architecture.
- Define the fuzzy systems
- Analyze the genetic algorithm and their applications.
- Get adequate knowledge about of FLC and NN toolbox.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC15.CO1	X	X	-	-	X	-	-	-	-	-	-	X	X	-	-
16PEC15.CO2	X	X	-	X	X	-	-	-	-	-	-	X	X	X	-
16PEC15.CO3	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-
16PEC15.CO4	X	X	X	X	X	-	-	-	-	-	-	-	-	X	-
16PEC15.CO5	X	X	X	X	X	-	-	-	-	-	-	X	X	X	-

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UNIT I INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS 9

Introduction of soft computing - soft computing vs hard computing- various types of soft computing techniques- applications of soft computing-Neuron- Nerve structure and synapse- Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- McCulloch Pitts neuron model- perceptron model- Adaline and Madaline- multilayer perception model- back propagation learning methods- effect of learning rule coefficient -back propagation algorithm- factors affecting back propagation training- applications.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Counter propagation network- architecture- functioning & characteristics of counter- Propagation network-Hopfield/ Recurrent network- configuration- stability constraints-associative memory- and characteristics- limitations and applications- Hopfield v/s Boltzmann machine- Adaptive Resonance Theory- Architecture- classifications-Implementation and training-Associative Memory.

UNIT III FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification- inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems – Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system

UNIT IV GENETIC ALGORITHM 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

UNIT V APPLICATIONS 9

GA application to power system optimization problem- Case studies: Identification and control of linear and nonlinear dynamic systems using MATLAB-Neural Network toolbox. Stability analysis of Neural Network interconnection systems- Implementation of fuzzy logic controller using MATLAB fuzzy logic toolbox-Stability analysis of fuzzy control systems

TOTAL: 45

16PEC14 REAL TIME OPERATING SYSTEM

COURSE OBJECTIVES

- To study about the different program models for embedded system programming
- To study about the inter-process communication and synchronization in embedded system
- To Study about OS services, file, I/O and memory management, interrupt handling and scheduling mechanism in RTOS
- To study about the RTOS Programming concepts
- To study about the an Embedded System by programming using RTOS µCOS-II

COURSE OUTCOMES

- Explain the different program models for embedded system programming.
- Explain inter-process communication and synchronization in embedded System
- Explain OS services, file, I/O and memory management, interrupt handling and scheduling mechanism in RTOS
- Explain the RTOS Programming concepts
- Design an Embedded System by programming using RTOS µCOS-II

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PEC14.CO1	X	X	-	-	X	-	-	-	-	X	-	X	X	-	-
16PEC14.CO2	X	X	-	X	X	-	-	-	-	X	-	X	X	X	-
16PEC14.CO3	X	X	X	X	X	-	-	-	-	X	-	X	X	X	-
16PEC14.CO4	X	X	X	X	X	-	-	-	-	X	-	-	-	X	-
16PEC14.CO5	X	X	X	X	X	-	-	-	-	X	-	X	X	X	-

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UNIT I INTRODUCTION AND PROGRAMMING OF EMBEDDED SYSTEMS 9

Embedded system, Overview and Design process, Program modeling concepts, Polling for events model, Concurrent process model, DFG models, State machine programming model, UML modeling.

UNIT II INTER-PROCESS COMMUNICATION AND SYNCHRONIZATION 9

Multiple processes, Multiple threads, Tasks, Task state and Task data, Semaphores, Shared data, Inter-process communication, Signal, message queue and mailbox functions, Pipe, socket and RPC functions.

UNIT III REAL TIME OPERATING SYSTEMS 9

OS services- process management, Timer and event functions, Memory, device, file and I/O subsystem management, Interrupt routine in RTOS environment, Basic design using an RTOS, RTOS task scheduling models, Interrupt latency and response of tasks, OS security issues.

UNIT IV RTOS PROGRAMMING 9

Basic functions and types of RTOSes. RTOS µCOS-II- basics, Functions in µCOS-II, Embedded linux system architecture.

UNIT V DESIGN EXAMPLES WITH µcos-II 9

Automatic chocolate vending machine, Digital Camera.

TOTAL: 45

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