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 : PSE

Programme Name : M.E-Power Systems Engineering

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 OF ELECTRICAL AND ELECTRONICS ENGINEERING

GROUPING OF COURSES

FOUNDATION COURSES

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PSA01	Advanced Numerical Methods	FC	5	3	2	0	4
2.	16PSA02	Applied Mathematics	FC	5	3	2	0	4
3.	16PSA03	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.	16PSB01	Linear and Non-Linear Systems Theory	PC	3	3	0	0	3
2.	16PSB02	Electrical Transients in Power Systems	PC	3	3	0	0	3
3.	16PSB03	Advanced Power System Analysis	PC	5	3	2	0	4
4.	16PSB04	Advanced Power System Operation and Control	PC	5	3	0	2	4
5.	16PSB05	Advanced Power System Dynamics	PC	3	3	0	0	3
6.	16PSB06	Flexible AC Transmission Systems	PC	3	3	0	0	3
7.	16PSB07	Advanced Power System Protection	PC	3	3	0	0	3
8.	16PSB08	Restructured Power System	PC	5	3	0	2	4
9.	16PSB09	Distributed Generation and Micro Grid	PC	3	3	0	0	3
10.	16PSB10	Power System Security	PC	3	3	0	0	3
11.	16PSB11	Industrial Power System Analysis and Design	PC	3	3	0	0	3
12.	16PSB12	Power System Planning and Reliability	PC	3	3	0	0	3

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PROFESSIONAL ELECTIVE

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit
					L	T	P	C
1.	16PSC01	Substation Equipment & Design	PE	3	3	0	0	3
2.	16PSC02	Microcontroller Based System Design	PE	3	3	0	0	3
3.	16PSC03	Design and Analysis of Inverters	PE	3	3	0	0	3
4.	16PSC04	Power Quality	PE	3	3	0	0	3
5.	16PSC05	Advanced Digital Signal Processing	PE	3	3	0	0	3
6.	16PSC06	Energy Management and Auditing	PE	3	3	0	0	3
7.	16PSC07	High Voltage Direct Current Transmission	PE	3	3	0	0	3
8.	16PSC08	Application of MEMS Technology	PE	3	3	0	0	3
9.	16PSC09	Solar and Energy Storage Systems	PE	3	3	0	0	3
10.	16PSC10	Wind Energy Conversion Systems	PE	3	3	0	0	3
11.	16PSC11	Power Plant Instrumentation and Control	PE	3	3	0	0	3
12.	16PSC12	Smart Grid	PE	3	3	0	0	3
13.	16PSC13	Power Electronics for Renewable Energy Systems	PE	3	3	0	0	3
14.	16PSC14	Real time operating systems	PE	3	3	0	0	3
15.	16PSC15	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.	16PSD01	Project Work-Phase I	EEC	12	0	0	12	6
2.	16PSD02	Project Work-Phase II	EEC	24	0	0	24	12

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Department	Electrical and Electronics Engineering	
Programme	M.E – Power Systems Engineering	

SEMESTER – I

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1.	16PSA01	Applied Mathematics	FC	5	3	2	0	4	50	50	100
2.	16PSB01	Linear and Non Linear Systems Theory	PC	3	3	0	0	3	50	50	100
3.	16PSB02	Electrical Transients in Power Systems	PC	3	3	0	0	3	50	50	100
4.	16PSB03	Advanced Power System Analysis	PC	5	3	2	0	4	50	50	100
5.	16PSB04	Advanced Power System Operation and Control	PC	5	3	0	2	4	100	100	200
6.		Elective-I	PE	3	3	0	0	3	50	50	100
Total Credits								**21**	**700**		

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Department	Electrical and Electronics Engineering	
Programme	M.E – Power Systems Engineering	

SEMESTER – II

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1.	16PSB05	Advanced Power System Dynamics	PC	3	3	0	0	3	50	50	100
2.	16PSB06	Flexible AC Transmission Systems	PC	3	3	0	0	3	50	50	100
3.	16PSB07	Advanced Power System Protection	PC	3	3	0	0	3	50	50	100
4.	16PSB08	Restructured Power System	PC	5	3	0	2	4	100	100	200
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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Department	Electrical and Electronics Engineering	
Programme	M.E. – Power Systems Engineering	

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.	16PSD01	Project Work - Phase I	EEC	12	0	0	12	6	50	50	100
Total Credits								15	400		

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Department	Electrical and Electronics Engineering	
Programme	M.E. – Power Systems Engineering	

SEMESTER – IV

Sl. No.	Course Code	Course Name	Category	Contact Hrs	Hours/ Week			Credit	Maximum Mark		
					L	T	P	C	CA	ES	TOTAL
1	16PSD02	Project Work - Phase II	EEC	24	0	0	24	12	50	50	100
Total Credits								12	100		

TOTAL CREDITS -67

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16PSA01 **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
16PSA01.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16PSA01.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSA01.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSA01.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSA01.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; numerical stability analysis, method of lines – Wave equation: Explicit scheme - Stability of above schemes.

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

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coordinates: finite difference schemes – approximation of derivatives near a curved boundary while using a square mesh.

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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16PSA02 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 which 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
16PSA02.CO1	x	x	x	x	x	-	-	-	x	-	-	x	-	x	-
16PSA02.CO2	x	x	x	x	x	-	-	-	x	-	-	x	-	x	-
16PSA02.CO3	-	-	x	x	x	-	-	-	-	-	-	x	-	x	-
16PSA02.CO4	-	-	x	x	x	-	-	-	-	-	-	x	-	x	-
16PSA02.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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16PSA03 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 Analyze multivariate 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.
- Analyze multivariate probability

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSA03.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSA03.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSA03.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSA03.CO4	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSA03.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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16PSB01 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
16PSB01.CO1	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSB01.CO2	x	-	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSB01.CO3	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSB01.CO4	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x
16PSB01.CO5	x	x	x	-	x	-	-	-	x	x	x	x	-	-	x

L	T	P	C
3	0	0	3

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

WEB URLs

1. https://en.wikipedia.org/wiki/Linear_system
2. tutorial.math.lamar.edu/Classes/Alg/NonlinearSystems.aspx
3. nptel.ac.in/courses/108105019/
4. www.control.lth.se/media/Education/EngineeringProgram/.../lec04_2015eight.pdf
5. nptel.ac.in/courses/108103007/

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16PSB02 ELECTRICAL TRANSIENTS IN POWER SYSTEMS

COURSE OBJECTIVES

- To gain knowledge in the sources and effects of lightning, switching and temporary over voltages.
- Ability to model and estimate the over voltages in power system.
- To coordinate the insulation of power system and protective devices.
- Ability to model and analyze power system and equipment for transient over voltages using Electromagnetic Transient Program (EMTP).
- To compute power system transient

COURSE OUTCOMES

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

- Know the effects of lightning, switching and temporary over voltages.
- Model and estimate the over voltages in power system.
- Apply insulation coordination principles for power system protective devices.
- To model and analyze power system equipment for transient over voltages using Electromagnetic Transient Program (EMTP).
- Compute power system transient

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB02.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB02.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB02.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB02.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB02.CO5	-	x	x	-	-	-	-	-	-	x	-	x	x	-	-

L	T	P	C
3	0	0	3

UNIT I LIGHTNING OVERVOLTAGES 9

Mechanism and parameters of lightning flash, protective shadow, striking distance, electrogeometric model for lightning strike, Grounding for protection against lightning – Steady-state and dynamic tower-footing resistance, substation grounding Grid, Direct lightning strokes to overhead lines, without and with shield Wires.

UNIT II SWITCHING AND TEMPORARY OVERVOLTAGES 9

Switching transients – concept – phenomenon – system performance under switching surges, Temporary over voltages – load rejection – line faults – Ferro resonance, VFTO.

UNIT III TRAVELLING WAVES ON TRANSMISSION LINE 9

Circuits and distributed constants, wave equation, reflection and refraction – behavior of travelling waves at the line terminations – Lattice Diagrams – attenuation and distortion – multi-conductor system and multi velocity waves.

UNIT IV INSULATION CO-ORDINATION 9

Classification of over voltages and insulations for insulation co-ordination– Characteristics of protective devices, applications, location of arresters – insulation coordination in AIS and GIS

UNIT V COMPUTATION OF POWER SYSTEM TRANSIENTS 9

Modeling of power apparatus for transient studies – principles of digital computation – transmission lines, cables, transformer and rotating machines – Electromagnetic Transient program – case studies: line with short and open end, line terminated with R,L, C, transformer, and typical power system case study: simulation of possible over voltages in a high voltage substation.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Pritindra Chowdhari	Electromagnetic transients in Power System	John Wiley and Sons Inc.	2009
2.	Allan Greenwood	Electrical Transients in Power System	Wiley &Sons Inc. New York	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Klaus Ragaller	Surges in High Voltage Networks	Plenum Press, New York	1980.
2.	Rakosh Das Begamudre	Extra High Voltage AC Transmission Engineering	New age International (P) Ltd.	2006

WEB URLs

1. www.leonardo-energy.org/good.../transient-and-temporary-over-voltages-and-current
2. www.openelectrical.org/wiki/index.php?title=Travelling_Wave_Line_Model
3. https://tspace.library.utoronto.ca/bitstream/1807/9971/1/Semlyen_9842_2826.pdf
4. www.electrical4u.com/insulation-coordination-in-power-system/
5. https://tspace.library.utoronto.ca/bitstream/1807/17080/1/Semlyen_679_2948.pdf

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16PSB03 ADVANCED POWER SYSTEMS ANALYSIS

COURSE OBJECTIVES

- To introduce different techniques of dealing with sparse matrix for large scale power systems.
- To impart in-depth knowledge on different methods of power flow solutions.
- To perform optimal power flow solutions in detail.
- To perform short circuit fault analysis and understand the consequence of different type of faults.
- To Illustrate different numerical integration methods and factors influencing transient stability.

COURSE OUTCOMES

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

- Model various power system components that are adequate for the basic system studies of load flow and short-circuit.
- Facilitate the modification of the Bus admittance matrix to reflect the network changes.
- Perform power flow analysis using NR, FDLF methods.
- Perform short circuit fault analysis and understand the consequence of different type of faults.
- Illustrate different numerical integration methods and factors influencing transient stability.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB03.CO1	x	-	x	x	x	x	-	-	-	x	x	x	x	x	-
16PSB03.CO2	x	x	-	x	x	x	-	-	x	x	-	x	x	-	-
16PSB03.CO3	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-
16PSB03.CO4	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-
16PSB03.CO5	x	x	x	x	x	x	-	-	x	x	x	x	x	x	-

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3	2	0	4

UNIT I POWER SYSTEM COMPONENTS AND ADMITTANCE MODEL 15

Classical Model of Synchronous machine – Modeling of transmission Network consisting of Transmission lines (long, medium and short lines) – Transformers (two winding, ULTC, phase shifting and three winding) –Branch and Node Admittances - Mutually Coupled Branches in Ybus - An Equivalent Admittance Network - Modification of Ybus - The Network Incidence Matrix and Ybus.

UNIT II THE IMPEDANCE MODEL AND NETWORK CALCULATIONS 15

The Method of Successive Elimination - Node Elimination (Kron Reduction) - Triangular Factorization - Sparsity and Near-Optimal Ordering. The Bus Admittance and Impedance Matrices - Thevenin's Theorem and Zbus - Modification of an Existing Zbus - Direct Determination of Zbus - Calculation of Zbus Elements from Ybus - Mutually Coupled Branches in Zbus.

UNIT III POWER-FLOW SOLUTIONS 15

The Power-flow Problem - Review of Newton-Raphson Power-flow Solution - Power-flow Studies in System Design and Operation - Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment - solution of optimal power flow (OPF) - Gradient method, newton's method.

UNIT IV SHORTCIRCUITANALYSIS 15

Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase – symmetrical and un symmetrical faults.

UNIT V TRANSIENTSTABILITYANALYSIS 15

Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model ; Factors influencing transient stability, Numerical stability and implicit Integration methods.

TOTAL: 75

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John J. Grainger and Stevenson	Power System Analysis	TATA McGraw Hill	1994
2.	A.Pai	Computer techniques in power system analysis	TATA McGraw Hill	2006
3.	G.W.Stagg & A.H.EL-Abaid	Computer methods in power system analysis	TATA McGraw Hill	1987
4.	L.P.Singh	Advanced power system analysis and dynamics	Wiley Eastern Ltd	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	George L. Kusic	Computer Aided Power system Analysis	Prentice Hall of India Ltd	2008
2.	Nagrath.I.J and Kothari.D.P.	Modern power system analysis	TATA McGraw Hill	2006
3.	J. Duncan Glover, Mulukutla S. Sarma and Thomas J.	Power System Analysis & Design	Cengage Learning	2011

WEB URLs

1. www.eeh.ee.ethz.ch/uploads/tx_ethstudies/modelling_hs08_script_02.pdf
2. https://pantherfile.uwm.edu/yu/www/power/imsld001.htm
3. www.powerflowsolutions.co.uk/
4. ecmweb.com › content
5. nptel.ac.in/courses/108104051/3

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16PSB04 ADVANCED POWER SYSTEM OPERATION AND CONTROL

COURSE OBJECTIVES

- To understand the fundamentals of speed governing system and the concept of control areas.
- To provide knowledge about Hydro thermal scheduling.
- Understand Unit commitment techniques.
- To understand the role of energy control center, SCADA and EMS functions.
- To have hands on experience on various system studies and different techniques used for system planning.
- To perform the dynamic analysis of power system.

COURSE OUTCOMES

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

- Explain the concept of AGC and analysis of multi-area system.
- Acquire knowledge about Hydrothermal scheduling
- Understand Unit commitment techniques.
- Illustrate various operating states of power system and control actions.
- Calculate the economic load dispatch for a system.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB04.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16PSB04.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB04.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB04.CO4	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSB04.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

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3	0	2	4

UNIT I INTRODUCTION 9

System load variation: System load characteristics, load curves-daily, weekly and annual, load-duration curve, load factor, diversity actor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, techniques of forecasting, basics of power system operation and control.

UNIT II REAL POWER-FREQUENCY CONTROL 9

Fundamentals of speed governing mechanism and modeling:Speed-load–characteristics – Load sharing between two synchronous machines in parallel; concept of control area, LFC control of a single-area system: Static and dynamic analysis of uncontrolled and controlled cases, Economic Dispatch Control. Multi-area systems: Two area system modeling; static analysis, uncontrolled case; tie line with frequency bias control of two-area system derivation, state variable model.

UNIT III HYDROTHERMAL SCHEDULING PROBLEM 9

Hydrothermal scheduling problem: short term and long term-mathematical model, algorithm. Dynamic programming solution methodology for Hydro-thermal scheduling with pumped hydro plant: Optimization with pumped hydro plant-Scheduling of systems with pumped hydro plant during off-peak seasons: algorithm. Selection of initial feasible trajectory for pumped hydro plant-Pumped hydro planet as spinning reserve unit- generation of outage induced constraint-Pumped hydro plant as Load management plant.

UNITIV UNITCOMMITMENT AND ECONOMIC DISPATCH 9

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints - UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems. Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. Base point and participation factors.-Economic dispatch controller added to LFC control.

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UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Energy control Centre: Functions–Monitoring, data acquisition and control. System hardware configuration–SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert, emergency, in-extremis and restorative-State transition diagram showing various state transitions and control strategies.

TOTAL: 45

LIST OF EXPERIMENTS:

1. Power flow analysis by Newton-Raphson method and Fast decoupled method.
2. Transient stability analysis of single machine-infinite bus system using classical machine model.
3. Contingency analysis: Generator shift factors and line outage distribution factors.
4. Economic dispatch using lambda-iteration method.
5. Unit commitment: Priority-list schemes and dynamic programming.
6. Analysis of switching surge using EMTP: Energisation of a long distributed- parameter line.
7. Analysis of switching surge using EMTP: Computation of transient recovery voltage.
8. Familiarization of Relay Test Kit.
9. Simulation and Implementation of Voltage Source Inverter.
10. Digital Over Current Relay Setting and Relay Coordination.
11. Co-ordination of over-current and distance relays for radial line protection.

TOTAL : 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Olle. I. Elgerd	Electric Energy Systems Theory – An Introduction	Tata McGraw Hill Publishing Company Ltd	2003
2.	L.L. Grigsby	The Electric Power Engineering, Hand Book	CRC Press & IEEE	-
3.	D.P. Kothari and I.J. Nagrath	Modern Power System Analysis	Tata McGraw Hill Publishing Company Limited	2003

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Allen.J.Wood and Bruce F.Wollenberg	Power Generation, Operation and Control	John Wiley & Sons, Inc	2003
2.	P.Kundur	Power System Stability & Control	McGraw Hill Publications	1994

WEB URLs

1. nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/power-system/...1/1_1.html
2. https://en.wikipedia.org/wiki/Automatic_Generation_Control
3. www.powerflowsolutions.co.uk/
4. link.springer.com/content/pdf/10.1007/978-1-4614-1752-1_4.pdf
5. nptel.kmeacollege.ac.in/syllabus/108108032/

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16PSB05 ADVANCED POWER SYSTEM DYNAMICS

COURSE OBJECTIVES

- To perform transient stability analysis using unified algorithm.
- To impart knowledge on sub-synchronous resonance and oscillations
- To analyze voltage stability problem in power system.
- To familiarize the methods of transient stability enhancement.
- Carry out dynamic performance measures of an excitation system.

COURSE OUTCOMES

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

- Model the power system components in stability studies.
- Explain the concept of Park's transformation and synchronous machine equations.
- Describe the concept of transient, steady state and dynamic stability.
- Analyze the stability of power system by point-by point method, Modified Euler's and Runge-Kutta method.
- Determine the critical clearing angle and clearing time for power system using equal area criterion.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB05.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB05.CO2	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB05.CO3	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB05.CO4	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB05.CO5	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-

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UNIT I TRANSIENT STABILITY ANALYSIS 9

Review of numerical integration methods: Euler and Fourth Order Runge-Kutta methods, Numerical stability and implicit methods, Interfacing of Synchronous machine (variable voltage) model to the transient stability algorithm (TSA) with partitioned – explicit and implicit approaches – Interfacing SVC with TSA-methods to enhance transient stability

UNIT II UNIFIED ALGORITHM FOR DYNAMIC ANALYSIS OF POWER SYSTEMS 9

Need for unified algorithm- numerical integration algorithmic steps-truncation error- variable step size – handling the discontinuities- numerical stability- application of the algorithm for transient. Mid-term and long-term stability simulations.

UNIT III SUBSYSNCHRONOUS RESONANCE (SSR) AND OSCILLATIONS 9

Sub synchronous Resonance (SSR) – Types of SSR - Characteristics of series – Compensated transmission systems –Modeling of turbine-generator-transmission network- Self-excitation due to induction generator effect – Torsional interaction resulting in SSR –Methods of analyzing SSR – Numerical examples illustrating instability of sub synchronous oscillations –time-domain simulation of sub synchronous resonance – EMTP with detailed synchronous machine model- Turbine Generator Torsional Characteristics: Shaft system model – Examples of torsional characteristics – Torsional Interaction with Power System Controls: Interaction with generator excitation controls – Interaction with speed governors – Interaction with nearby DC converters.

UNIT IV TRANSMISSION, GENERATION AND LOAD ASPECTS OF VOLTAGE STABILITY ANALYSIS 9

Review of transmission aspects – Generation Aspects: Review of synchronous machine theory – Voltage and frequency controllers – Limiting devices affecting voltage stability – Voltage-reactive power characteristics of synchronous generators – Capability curves – Effect of machine limitation on

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deliverable power – Load Aspects – Voltage dependence of loads – Load restoration dynamics – Induction motors – Load tap changers – Thermostatic load recovery – General aggregate load models.

UNIT V ENHANCEMENT OF TRANSIENT STABILITY AND COUNTER MEASURES FOR SUB SYNCHRONOUS RESONANCE 9

Principle behind transient stability enhancement methods: high-speed fault clearing, reduction of transmission system reactance, regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast-valving, high-speed excitation systems; NGH damper scheme.

TOTAL: 45

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	R.Ramnujam	Power System Dynamics Analysis and Simulation	PHI Learning Private Limited	2009
2.	M T.V.Cutsem and C.Vournas	Voltage Stability of Electric Power Systems	Kluwer publishers	1998
3.	P. Kundur	Power System Stability and Control	TATA McGraw Hill	1993

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	H.W. Dommel and N.Sato	Fast Transient Stability Solutions	IEEE Trans., Vol. PAS-91, pp, 1643-1650	1972.
2.	Roderick J.Frowd and J.C.Giri	Transient stability and Long term dynamics unified	IEEE Trans.	1982
3.	M.Stubbe, A.Bihain, J.Deuse, J.C.Baader	A New Unified software program for the study of the dynamic behaviour of electrical power system	IEEE Transaction, Power Systems	-

WEB URLs

1. https://www.youtube.com/watch?v=7gCMFzc0kHQ
2. https://www.youtube.com/watch?v=ctgC-bwsJV0
3. https://www.youtube.com/watch?v=oPwsrq29w18&spfreload=5
4. https://www.youtube.com/watch?v=tcBZtr2NE9g
5. https://books.google.co.in/books?isbn=8120335252

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16PSB06 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 controller

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 controller.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB06.CO1	x	x	-	-	x	-	-	-	-	-	-	-	x	x	x
16PSB06.CO2	x	x	-	-	-	-	-	-	-	-	-	x	x	x	-
16PSB06.CO3	x	x	-	-	x	-	-	-	x	-	-	-	x	x	x
16PSB06.CO4	x	x	-	-	-	-	-	-	-	-	-	x	x	x	-
16PSB06.CO5	x	x	x	-	-	-	-	-	-	-	-	-	x	x	-

L	T	P	C
3	0	0	3

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

WEB URLs

1. https://www.youtube.com/watch?v=olq593YoRuQ
2. https://www.youtube.com/watch?v=raD4yP6PKGc
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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16PSB07 ADVANCED POWER SYSTEM PROTECTION

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 select a suitable FACTS controller for a particular application.
- To analyze numerical protection

COURSE OUTCOMES

The students should 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.
- Analyze numerical protection

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB07.CO1	x	x	x	-	-	-	-	-	-	x	-	x	x	-	-
16PSB07.CO2	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16PSB07.CO3	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16PSB07.CO4	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-
16PSB07.CO5	x	x	x	-	-	x	-	-	x	x	-	x	x	-	-

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UNIT I OVER CURRENT PROTECTION 9

Zones of protection – Primary and Backup protection – operating principles and Relay Construction - Time – Current characteristics-Current setting – Time setting-Over current protective schemes - Reverse power or directional relay - Protection of parallel feeders - Protection of ring feeders - Earth fault and phase fault protection

UNIT II EQUIPMENT PROTECTION 9

Types of transformers – Phasor diagram for a three – Phase transformer-Equivalent circuit of transformer – Types of faults in transformers- Over – current protection Percentage Differential Protection of Transformers - Inrush phenomenon-High resistance Ground Faults in Transformers - Inter-turn faults in transformers - Incipient faults in transformers - Phenomenon of over-fluxing in transformers

UNIT III DISTANCE AND CARRIER PROTECTION OF TRANSMISSION LINES 9

Drawback of over – Current protection – Introduction to distance relay – Simple impedance relay – Reactance relay – mho relays comparison of distance relay – Distance protection of a three – Phase line-reasons for inaccuracy of distance relay reach - Three stepped distance protection - Trip contact configuration for the three - Stepped distance protection - Three-stepped protection of three-phase line against all ten shunt faults

UNIT IV BUSBAR PROTECTION 9

Introduction – Differential protection of bus bars-external and internal fault - Actual behaviors of a protective CT - Circuit model of a saturated CT - External fault with one CT saturation :need for high impedance

UNIT V NUMERICAL PROTECTION 9

Introduction–Block diagram of numerical relay - Sampling theorem- Correlation with a reference wave–Least error squared (LES) technique-Digital filtering-numerical over - Current protection–Numerical transformer differential protection-Numerical distance protection of transmission line.

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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	TATA McGraw Hill	1993
2.	Stanley Horowitz	Protective Relaying for Power System	IEEE press	2008

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	T.S.M. Rao	Digital Relay / Numerical relays	Tata McGraw Hill	1989
2.	Y.G. Paithankar and S.R Bhide	Fundamentals of Power System Protection	Prentice-Hall of India	2003

WEB URLs

1. www.electrical4u.com/over-current-relay-working-principle-types
2. www.mechprod.com/blog/.../overcurrent-protection-and-overcurrent-protection-devi...
3. https://www.youtube.com/watch?v=HB-wiDBuS4M
4. https://www.youtube.com/watch?v=iSrGhZNcFKU
5. https://www.youtube.com/watch?v=jH7lKx7o5Ug

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16PSB08 RESTRUCTURED POWER SYSTEM

COURSE OBJECTIVES

- To introduce the restructuring of power industry and market models.
- To impart knowledge on fundamental concepts of congestion management.
- To analyze the concepts of locational marginal pricing and financial transmission rights.
- To Illustrate about various power sectors in India
- To analyze the effect of FACTS controllers by performing steady state analysis.

COURSE OUTCOMES

The students should be able to,

- Explain the restructuring process, new entities in power market and benefits.
- Apply the concepts and terminologies used in interchange evaluation, power pools and transaction issues.
- Explain the Indian power system, issues, regulatory and policy developments and acts.
- Determine available transfer capability in restructured environment.
- Analyze the effect of FACTS controllers by performing steady state analysis.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB08.CO1	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16PSB08.CO2	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16PSB08.CO3	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16PSB08.CO4	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-
16PSB08.CO5	x	x	x	-	-	-	-	-	x	x	-	x	x	-	-

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UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality - Simultaneous feasibility test and revenue adequency

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service –Co-optimization of energy and reserve services - International comparison Transmission pricing

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff – Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future

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LIST OF EXPERIMENTS:

1. Small-signal stability analysis of single machine-infinite bus system using classical machine model
2. Small-signal stability analysis of multi-machine configuration with classical machine model
3. Induction motor starting analysis
4. Load flow analysis of two-bus system with STATCOM
5. Transient analysis of two-bus system with STATCOM
6. Available Transfer Capability calculation using an existing load flow program
7. Study of variable speed wind energy conversion system- DFIG
8. Study of variable speed wind energy conversion system- PMSG
9. Computation of harmonic indices generated by a rectifier feeding a R-L load
10. Design of active filter for mitigating harmonics.

TOTAL: 30

TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Sally Hunt	Making competition work in electricity	John Willey and Sons Inc	2002
2.	Steven Stoft	Power system economics: designing markets for electricity	John Wiley & Sons	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Mohammad Shahidehpour, Muwaffaq Alomoush and Marcel Dekker,	Restructured electrical power systems: operation, trading and volatility	Kluwer Academic Pub	2001
2.	Kankar Bhattacharya, Jaap E. Daadler and Math H.J. Boolen,	Operation of restructured power systems	Kluwer Academic Pub	2001

WEB URLs

1. https://www.youtube.com/watch?v=Bqn0YdeO9tg
2. http://nptel.ac.in/courses/108101005/18
3. https://www.youtube.com/watch?v=sSSa93S4v8M
4. http://www.powershow.com/view1/b8b02-ZDc1Z/Access_and_Pricing_Policies_for_Firm_Transmission_Service_powerpoint_ppt_presentation
5. https://www.youtube.com/watch?v=tjNDeUi0m30

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16PSB09 DISTRIBUTED GENERATION AND MICRO GRID

COURSE OBJECTIVES

- To illustrate the concept of distributed generation.
- To analyze the impact of grid integration.
- To study concept of Micro grid and its configuration.
- To design the dc micro grid.
- To analyze power quality issues and control operation of micro grid.

COURSE OUTCOMES

After Completion of this course students will be able to,

- 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 micro grid.
- Design the dc micro grid.
- Analyze power quality issues and control operation of micro grid.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB09.CO1	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16PSB09.CO2	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16PSB09.CO3	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16PSB09.CO4	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-
16PSB09.CO5	x	x	x	x	x	-	-	-	x	x	x	x	-	x	-

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UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages-Energy crises-Non- Conventional Energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations: Topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting distributed resources to electric power systems- IEEE 1547. DG installation classes-security issues in DG implementations-Energy storage elements: Batteries, ultra-capacitors-flywheels-Captive power plants.

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid inter connection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues-Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of micro grid, micro grid drivers and benefits, review of sources of micro grids, typical structure and configuration of a micro grid, AC and DC micro grids, Power Electronics interfaces in DC and AC micro grids.

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of micro grid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, micro grid communication infrastructure, Power quality issues in micro grids, regulatory standards, Micro grid economics, Introduction to smart micro grids

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Amir Naser Yezdani and Reza Iravani	Voltage Source Converters in Power Systems: Modeling, Control and Applications	John Wiley Publications	2004
2.	Dorin Neacsu	Power Switching Converters: Medium and High Power	CRC Press	2006

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Chetan Singh Solanki	Solar PhotoVoltaics	PHI learning Pvt. Ltd.	2009
2.	J.F. Manwell	Wind Energy Explained, theory design and applications	PHI learning Pvt. Ltd.	2006

WEB URLs

1. https://www.youtube.com/watch?v=jyHwd-O2IPs
2. https://www.youtube.com/watch?v=snDTBQoR_ro
3. https://www.youtube.com/watch?v=jib4MhKE8gE
4. https://www.youtube.com/watch?v=EhkdYqNU-ac
5. https://www.youtube.com/watch?v=XwA1UkjL49o

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16PSB10 POWER SYSTEM SECURITY

COURSE OBJECTIVES

- To assess the security level status of the large power system, if n-1 contingency takes place in the system.
- To analyze the large power system in terms of real power performance index (PI) or other PIs.
- To estimate the state of the power system in terms of its measured values.
- To optimize the power flow in terms of real and reactive power with the possible various objectives and constraints involved in energy management system.
- To use appropriate OPF technique depending on the formulation of optimization which involves non-linear objective and constraints.

COURSE OUTCOMES

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

- Assess the security level status of the large power system, if n-1 contingency takes place in the system.
- Analyze the large power system in terms of real power performance index (PI) or other PIs.
- Estimate the state of the power system in terms of its measured values.
- Optimize the power flow in terms of real and reactive power with the possible various objectives and constraints involved in energy management system.
- Use appropriate OPF technique depending on the formulation of optimization which involves non-linear objective and constraints.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB10.CO1	-	x	x	-	-	x	x	-	-	x	-	x	-	-	-
16PSB10.CO2	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16PSB10.CO3	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16PSB10.CO4	x	x	x	-	-	x	x	-	-	x	-	x	x	-	-
16PSB10.CO5	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-

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UNIT I BASICS OF POWER SYSTEM SECURITY 9

Factors affecting power system security- decomposition and multilevel approach- state estimation- system monitoring- security assessment and security enhancement.

UNIT II POWER SYSTEM STATE ESTIMATION 9

Maximum likelihood weighted least-square estimation- state estimation- detection and identification of bad measurements- estimation of quantities not being measure- network observability and pseudo measurements.

UNIT III SECURITY ASSESSMENT 9

Detection of network problems- network equivalent for external system- network sensitivity methods- calculation of network sensitivity factors- fast contingency algorithms- contingency ranking- dynamic security indices.

UNIT IV SECURITY ENHANCEMENT 9

Correcting the generator dispatch by sensitivity methods- compensated factors- security constrained optimization- preventive- emergency and restorative control through NLP and LP methods.

UNIT V RECENT TECHNIQUES 9

Voltage security assessment-Transient Security assessment-methods-Comparison.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John J.Graignaer and William D. Stevenson	Power system analysis	Tata McGraw Hill	2003
2.	P.Venkatesh, B.V.Manikandan, S.Charles raja and A.Srinivasan	Electrical power systems analysis, Security and Deregulation	PHI	2012

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.J.Wood and B.F.Wollenberg	Power generation, operation and control	John Wiley and sons	1996

WEB URLs

1. https://www.youtube.com/watch?v=hOGlLQFJ3m0
2. https://www.youtube.com/watch?v=Zb1wZAdXgLA
3. http://www.powershow.com/view/1285f5-NGY4M/Security_Assessment_and_Methodologies_powerpoint_ppt_presentation
4. https://www.youtube.com/watch?v=MJnJtVjwrQ4
5. https://www.youtube.com/watch?v=2nCVvhlBzzk

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16PSB11 INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN

COURSE OBJECTIVES

- To analyze the motor starting and power factor correction.
- To perform computer-aided harmonic and flicker analysis and to design filters.
- To expose various grid grounding methodologies..
- To understand the flicke analysis.
- To analyze ground grid.

COURSE OUTCOMES

- Know the severity of power quality problems in distribution system.
- Understand the concept of voltage sag transformation from up-stream (higher voltages) to down-stream (lower voltage).
- Compute the concept of improving the power quality to sensitive load by various mitigating custom power devices.
- To understand the flicke analysis.
- To analyze ground grid.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB11.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16PSB11.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB11.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB11.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSB11.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-

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UNIT I MOTOR STARTING STUDIES 9

Introduction-Evaluation Criteria-Starting Methods-System Data-Voltage Drop Calculations-Calculation of Acceleration time-Motor Starting with Limited-Capacity Generators-Computer-Aided Analysis-Conclusions.

UNIT II POWER FACTOR CORRECTION STUDIES 9

Introduction-System Description and Modeling-Acceptance Criteria-Frequency Scan Analysis-Voltage Magnification Analysis-Sustained Over voltages-Switching Surge Analysis-Back-to-Back Switching-Summary and Conclusions.

UNIT III HARMONIC ANALYSIS 9

Harmonic Sources-System Response to Harmonics-System Model for Computer-Aided Analysis - Acceptance Criteria - Harmonic Filters-Harmonic Evaluation-Case Study- Summary and Conclusions.

UNIT IV FLICKE ANALYSIS 9

Sources of Flicker-Flicker Analysis-Flicker Criteria-Data for Flicker analysis- Case Study- Arc Furnace Load-Minimizing the Flicker Effects-Summary.

UNIT V GROUND GRID ANALYSIS 9

Introduction-Acceptance Criteria-Ground Grid Calculations-Computer-Aided Analysis - Improving the Performance of the Grounding Grids-Conclusions.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	RamasamyNatarajan	Computer-Aided Power System Analysis	Marcel DekkerInc	2002
2.	ArindamGhosh	Power Quality Enhancement Using Custom Power Devices	Springer International Edition	2002

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G.T.Heydt	Electric Power Quality	Stars in a Circle Publications	2nd edition 1994

WEB URLs

1. http://www.powershow.com/view1/696b8-ZDc1Z/Motor_Starting_Analysis_powerpoint_ppt_presentation
2. https://www.youtube.com/watch?v=WPazzbky4x4
3. https://www.youtube.com/watch?v=eNBm9wD9zg0
4. https://www.youtube.com/watch?v=zkkGINEOim0

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16PSB12 POWER SYSTEM PLANNING AND RELIABILITY

COURSE OBJECTIVES

- To introduces the objectives of Load forecasting.
- To study the fundamentals of Generation system, transmission system and Distribution system reliability analysis
- To illustrate the basic concepts of Expansion planning.
- To describe the reliability functions with their relationships and Markov modeling.
- To evaluate reliability models using frequency and duration techniques and generate various reliability models.

COURSE OUTCOMES

- Understand how the Power Market operates in a deregulated Electrical Power Industry.
- Know the significance of generation planning and transmission planning for power system reliability and security assessment.
- Understand the concept of probability theory, distribution, network modelling and reliability analysis.
- Describe the reliability functions with their relationships and Markov modeling.
- Evaluate reliability models using frequency and duration techniques and generate various reliability models.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSB12.CO1	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16PSB12.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16PSB12.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16PSB12.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x
16PSB12.CO5	x	x	x	x	-	-	-	-	-	x	-	x	x	x	x

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UNIT I LOAD FORECASTING 9

Objectives of forecasting - Load growth patterns and their importance in planning - Load forecasting Based on discounted multiple regression technique-Weather sensitive load forecasting-Determination of annual forecasting-Use of AI in load forecasting.

UNIT II GENERATION SYSTEM RELIABILITY ANALYSIS 9

Probabilistic generation and load models- Determination of LOLP and expected value of demand not served –Determination of reliability of iso and interconnected generation systems.

UNIT III TRANSMISSION SYSTEM RELIABILITY ANALYSIS 9

Deterministic contingency analysis-probabilistic load flow-Fuzzy load flow probabilistic transmission system reliability analysis-Determination of reliability indices like LOLP and expected value of demand not served.

UNIT IV EXPANSION PLANNING 9

Basic concepts on expansion planning-procedure followed for integrate transmission system planning, current practice in India-Capacitor placer problem in transmission system and radial distributions system.

UNIT V DISTRIBUTION SYSTEM PLANNING OVERVIEW 9

Introduction-Sub transmission lines and distribution substations-Design primary and secondary systems-distribution system protection and coordination of protective devices.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Roy Billinton & Ronald N. Allan	Reliability Evaluation of Power System	Springer Publication.	-
2.	R.L. Sullivan	Power System Planning	Tata McGraw Hill Publishing Company Ltd	-
3.	X. Wang & J.R. McDonald	Modern Power System Planning	McGraw Hill Book Company	-

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	T. Gönen,	Electrical Power Distribution Engineering	McGraw Hill Book Company	-
2.	B.R. Gupta	Generation of Electrical Energy	S. Chand Publications	-

WEB URLs

1. https://www.youtube.com/watch?v=_V3zJkgG3zk
2. https://www.youtube.com/watch?v=S70BIoEXLlk
3. https://www.youtube.com/watch?v=Xw0QR9-vDOo
4. https://www.youtube.com/watch?v=fnqiRmPoy_c
5. https://www.youtube.com/watch?v=Vu7FJvL8ArA

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16PSC01 SUBSTATION EQUIPMENT & DESIGN

COURSE OBJECTIVES

- Identify the functions of various operating components of an electric power substation, and recognize them by their appearance.
- Define the various terms and applications involved with substations and the distribution of electric power.
- Discuss the factors that go into planning a substation, such as location, environmental concerns, and electrical system diagraming.
- List the main components involved with electric power substations and distribution systems.

COURSE OUTCOMES

- Operate and maintain Gas insulated Substation.
- Maintain Substation earthing.
- Analyze various Power Quality problems.
- Apply techniques to mitigate Power Quality disturbance and transients.
- Apply techniques to mitigate harmonics.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSC01.CO1	x	-	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSC01.CO2	x	x	-	-	-	x	-	-	x	x	-	x	x	x	-
16PSC01.CO3	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16PSC01.CO4	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-
16PSC01.CO5	x	x	x	x	-	x	-	-	x	x	x	x	x	x	-

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UNIT I SUBSTATION EARTHING SYSTEMS 9

Functional Requiements of Earthing System, Equipment Earthing, Neutral Point Earthing, Substation Earthing System, Dimensioning of Earth Conductors, Step Potential and Touch Potential, Earth Mat, Resistance of Earthing System, Values of Soil Resistivity, Fencing, Procedure of Laying Earthing – Mat, Measurement of Earthing Resistance.

UNIT II POWER CABLES AND CONTROL CABLES 9

Power Cables, Types of Conventional Power Cables, Laying of Power Cables, Control Cables, Principles of Control Cable Installation, Sensitivity of Various Loads to interference , Measuring Cables , Grounding of Cable Trays, Ducts, Electrical Noise.

UNIT III PROTECTION, CONTROL AND AUTOMATION IN SUBSTATIONS 9

Control Panels, Protective Relaying in Substations, Power Transformer Protection, Bus Zone Protection, Protection of Transmission Lines, Carrier Assisted Distance Protection, Control and Automation, Fault Diagnostics.

UNIT IV HVDC AND EHVACSUBSTATIONS 9

Layout of a HVDC Substation, A.C. Switchyard, A.C. Harmonic Filter Area, Convertor- transformers, Valve Hall and Control Room, HVDC Yard, D.C. Smoothing Reactors, Earth Return, D.C, Breaker and Load break switches, Electrical and mechanical auxiliaries, Operating HVDC Back to Back Coupling Stations, EHVAC Substations, Configuration of EHV-AC

UNIT V INSTALLATION, COMMISSIONING AND SAFETY PROCEDURES 9

Installation safety procedures, Installation of Earthing System, Installation of Yard equipment, Drying of Electrical Equipment, Measurement of Insulation Resistance and Polarization Index of transformers, Commissioning of Substations, Equipment tests, Sub-Systems tests on protection systems, Phasing tests.

TOTAL: 45

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	John D. McDonald	Electric Power Substations Engineering	CRC Press	2007

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	A.S. Pabla	Electric Power Distribution	Tata McGraw Hill	2011
2.	Paul Gill	Electrical Power Equipment Maintenance and Testing	CRC press	2008

Web URL:

1. https://www.youtube.com/watch?v=NXtA5rxJXGA
2. https://www.youtube.com/watch?v=9A_HzR-wmas
3. https://www.youtube.com/watch?v=_au1vWIsL1U
4. https://www.youtube.com/watch?v=NSaeW6C94Ww
5. https://www.youtube.com/watch?v=BwhNCpt9_d0

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16PSC02 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
16PSC02.CO1	-	x	x	-	-	x	x	-	-	x	-	x	-	-	-
16PSC02.CO2	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16PSC02.CO3	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-
16PSC02.CO4	x	x	x	-	-	x	x	-	-	x	-	x	x	-	-
16PSC02.CO5	x	x	x	-	-	x	-	-	-	x	-	x	x	-	-

L	T	P	C
3	0	0	3

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

WEB URLs:

1. https://www.youtube.com/watch?v=CxtwG8B7ihA
2. https://www.youtube.com/watch?v=tjZ2Mh_MV6g
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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16PSC03 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 design and analyze the resonant inverter.

COURSE OUTCOMES

- Suggest the application of single phase inverters
- Demonstrate the operation of three phase inverters.
- Analyze the operation of CSI inverter.
- Evaluate the performance of multilevel inverter.
- Design and analyze the resonant inverter.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSC03.CO1	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC03.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC03.CO3	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC03.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC03.CO5	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-

L	T	P	C
3	0	0	3

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.

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 using various PWM techniques – 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

WEB URLs

1. www.explainthatstuff.com/how-inverters-work.html
2. www.ti.com/lit/pdf/tiduay6
3. https://en.wikipedia.org/wiki/Z-source_inverter
4. https://www.elprocus.com/multilevel-inverter-types-advantages/
5. https://en.wikipedia.org/wiki/Resonant_inverter

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16PSC04 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 analyze series compensation and power distribution system

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.
- Analyze series compensation and power distribution system

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSC04.CO1	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC04.CO2	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC04.CO3	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC04.CO4	x	x	x	x	-	-	-	-	-	x	-	x	-	x	-
16PSC04.CO5	-	x	x	x	-	-	-	-	-	x	-	x	-	x	-

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3	0	0	3

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)

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

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.

TOTAL: 45

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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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16PSC05 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

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

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSC05.CO1	x	x	-	-	-	-	-	-	-	x	-	x	x	-	-
16PSC05.CO2	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSC05.CO3	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSC05.CO4	x	x	x	x	-	-	-	-	-	x	-	x	x	x	-
16PSC05.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 (Blackfin), 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, PID Controller, Application for Serial Interfacing, DSP based Power Meter, Position control, CODEC Interface.

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, Realisation 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 G.Manolakis	Digital Signal Processing	Pearson Education	2002
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

WEB URLs

1. https://www.youtube.com/watch?v=wmdEUzI73t0
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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16PSC06 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

- 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
16PSC06.CO1	-	X	X	-	-	X	X	-	-	X	-	X	-	-	-
16PSC06.CO2	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PSC06.CO3	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PSC06.CO4	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
16PSC06.CO5	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-

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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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16PSC07 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
16PSC07.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PSC07.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC07.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC07.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC07.CO5	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-

L	T	P	C
3	0	0	3

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.

TOTAL: 45

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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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16PSC08 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
16PSC08.CO1	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PSC08.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PSC08.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PSC08.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	X
16PSC08.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 CASESTUDIES 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.	ChangLiu Robbin	FoundationsofMEMS	PearsonInternationalEdition edition	2006
2.	MarcMadou	Fundamentalsofmicrofabrication	CRCPress	1997
3.	Boston	MicromachinedTransducersSourcebook	WCBMcGrawHill	1998

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	M.H.Bao	Micromechanicaltransducers:Pressuresensors,accelerometersandgyroscopes	Elsevier,Newyork	2000
2.	P.RaiChoudry	MEMSandMOEMSTechnologyandApplications	PHI	2012
3.	StephenD.Senturia	Microsystem Design	SpringerInternational 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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16PSC09 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 sources power.
- To explain simulation and modeling of solar photovoltaic systems.
- To experiment on solar cell and solar 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 sources power.
- Explain simulation and modeling of solar photovoltaic systems.
- Experiment on solar cell and solar 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 Photovoltaics	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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16PSC10 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

- 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
16PSC10.CO1	-	X	X	-	-	X	X	-	-	X	-	X	-	-	-
16PSC10.CO2	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PSC10.CO3	X	X	X	-	-	X	-	-	-	X	-	X	X	-	-
16PSC10.CO4	X	X	X	-	-	X	X	-	-	X	-	X	X	-	-
16PSC10.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	Variabie 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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16PSC11 POWER PLANT INSTRUMENTATION AND CONTROL

COURSE OBJECTIVES

- To explain the basic principles of power system instrumentation and control.
- To illustrate the boiler operation and its control in a thermal power plant.
- To determine the performance of various power plant instrumentation and control systems.
- To choose from currently commercially available power plant instrumentation and control systems for a given application.
- To analyze the setting demand for the steam generator
- To control the boiler.

COURSE OUTCOMES

- Explain the basic principles of power system instrumentation and control.
- Illustrate the boiler operation and its control in a thermal power plant.
- Determine the performance of various power plant instrumentation and control systems.
- Choose from currently commercially available power plant instrumentation and control systems for a given application.
- Analyze the setting demand for the steam generator
- Control the boiler.

Course Outcomes	Program Outcomes												PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
16PSC11.CO1	x	x	-	-	x	-	-	-	-	x	-	x	x	-	-
16PSC11.CO2	x	x	-	x	x	-	-	-	-	x	-	x	x	x	-
16PSC11.CO3	x	x	x	x	x	-	-	-	-	x	-	x	x	x	-
16PSC11.CO4	x	x	x	x	x	-	-	-	-	x	-	-	-	x	-
16PSC11.CO5	x	x	x	x	x	-	-	-	-	x	-	x	x	x	-

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UNIT I OVERVIEW OF POWER GENERATING STATIONS 9

Brief survey of different methods of conventional power generation (hydro, thermal and nuclear)-Importance of instrumentation in power generating stations.

UNIT II BASICS OF STEAM GENERATION IN THERMAL POWER PLANTS 9

Process of power generation in coal-fired and oil fired in thermal power plants-Nature of steam-Thermal efficiency-Gas turbine and combined cycle plants-Steam turbine and use-Steam turbine.

UNIT III WATER, FUEL, AIR AND FLUE GAS CIRCUITS 9

The condensate and feed water system Feed pumps and valves-The water and steam circuits in HRSC plant.

UNIT IV SETTING THE DEMAND FOR THE STEAM GENERATOR 9

Nature of the demand-Setting the demand in power stations applications-Master demand in power station applications-Load demand in combined heat and power plants-Waste to energy plants.

UNIT V BOILER CONTROL 9

The principles of compression control-Draught control-The principles of feed water control-One, two and three elements feed water control-Drum level control-Steam temperature control-Spray-water at temperature-Temperature control with tilting burners-controlling temperature of reheated steam-Gas Recycling.

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TEXT BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David Lindsley	Power Plant Control & Instrumentation	IEE Publications UK	(2001)
2.	Sam G.Dukelow	The control of Boilers	Instrument Society of America	1991
3.	Elonka S.M. and Kohal A.L	Standard Boiler Operators	McGraw Hill, New Delhi	1994

REFERENCE BOOKS:

Sl.No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	Doebelin	Measurement Systems	5th edition, Tata McGraw-Hill	2007
2.	P.K.Nag	Power Plant Engineering	", Tata McGraw-Hill, New Delhi	2005

WEB URLs

1. https://www.youtube.com/watch?v=gggqvitMDuY
2. https://www.youtube.com/watch?v=2VSzutk8C6g
3. https://www.youtube.com/watch?v=ie0jPIfGxOU
4. https://www.youtube.com/watch?v=7M9FHu4WDc0
5. https://www.youtube.com/watch?v=7MV3-vl4wZQ

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16PSC12 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
16PSC12.CO1	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PSC12.CO2	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PSC12.CO3	-	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PSC12.CO4	X	X	X	X	-	-	-	-	-	X	-	X	-	X	-
16PSC12.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.

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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 Dejun Yang	Smart Grid – The New and Improved Power Grid: A Survey	IEEE Transaction on Smart Grids	2011

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 Ekanayake, Nick Jenkins, KithsiriLiyanage, 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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16PSC13 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
16PSC13.CO1	X	X	-	-	-	-	-	-	-	X	-	X	X	-	-
16PSC13.CO2	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC13.CO3	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC13.CO4	X	X	X	X	-	-	-	-	-	X	-	X	X	X	-
16PSC13.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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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	-

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://www.youtube.com/watch?v=x2RUogerZck
5. www.youtube.com/watch?v=NoGYYsOkOA8

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16PSC14 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
16PSC14.CO1	X	X	-	-	X	-	-	-	-	X	-	X	X	-	-
16PSC14.CO2	X	X	-	X	X	-	-	-	-	X	-	X	X	X	-
16PSC14.CO3	X	X	X	X	X	-	-	-	-	X	-	X	X	X	-
16PSC14.CO4	X	X	X	X	X	-	-	-	-	X	-	-	-	X	-
16PSC14.CO5	X	X	X	X	X	-	-	-	-	X	-	X	X	X	-

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3	0	0	3

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.

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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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16PSC15 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	-

L	T	P	C
3	0	0	3

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.

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.

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.

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

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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, Algorithms And Applications.	Pearson Education	2010
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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