Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	System Theory	L	T	P	C	CA	EA	Total
115PST01		3	1	0	4	50	50	100

Prerequisite: Nil

Objectives
:

1. To gain knowledge about state variable representation models.
2. To understand reduction techniques and realization of transfer functions.
3. To get exposed to state space design and analysis of non-linear systems.

UNIT – I **STATE SPACE ANALYSIS & CONTROLLABILITY, OBSERVABILITY** 12

Introduction to state variable representation models of linear continuous time system solution of state equation by various methods. Diagonalization of matrices. Calculation of generalized eigen vectors. Reduction to canonical and Jordan's canonical form. Gilberts and Kalman's test for controllability and observability.

UNIT - II **TRANSFER FUNCTION AND STATE SPACE DESIGN** 12

Impulse response and transfer function matrices. Properties of transfer functions, reducibility, Realization of transfer functions. State space design. Design by state feedback and pole placements.

UNIT - III **NONLINEAR SYSTEMS** 12

Types of non-linear phenomena- singular points- phase plane method- construction of phase trajectories- Derivation of describing functions. Need for model reduction-dominant pole concept-model reduction via partial realization-time moment matching and pade approximation-Hankel norm model reduction.

UNIT - IV **STABILITY CONCEPTS** 12

Stability concepts – Equilibrium points –BIBO and asymptotic stability,isoclines equilibrium points stability concepts- Lyaponouv's stability criteria- Stability of non-linear systems by describing function method- jump resonance. Frequency domain stability criteria- Popov's criterion.

UNIT - V **OPTIMAL CONTROL & ADAPTIVE CONTROL** 12

Formulation of optimal control problems- solving of optimal control problems – Hamiltonian formulation- linear regulator problem- solution of Richatti equation- Pontryagin's minimum principle- time optimal control. Classification of adaptive control systems-MRAC systems-different configuration- classification- Mathematical description.

Lecture: 45, Tutorial: 15, TOTAL: 60

COURSE OUTCOMES(COS)

CO1: Acquire the concept of State-State equation for Dynamic Systems and understand the uniqueness of state model.

CO2: Ability to differentiate the existence and uniqueness of Continuous time state equations.

CO3: Ability to analyse the controllability and observability of a system.

CO4: Acquire detail knowledge on stability analysis of Linear & Nonlinear Continuous Time Autonomous Systems.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	L	PSO1	PSO2	PSO3
CO1	2	2		2									2	2	
CO2	2	3		2									2	1	
CO3		3	2	2									1	2	1
CO4	2	2		3									2	2	

REFERENCE BOOK(s) :

1 Nagrath I.J., and Gopal, M., "Control Systems Engineering" New Age International (P) Limited, 2010.

2 Gopal. M., "Modern control system Theory", Wiley Eastern Ltd., 2nd Edition Reprint 1995.

3 Graham C., Goodwill, S.Graebe and M.Salgado, "Control System Design" Prentice Hall India, New Delhi, 2000.

4 Astrom K.J., and Wittenmark B., "Adaptive control", Addison-Wesley Longman Publishing Co, Second Edition,1994.

5 K.Ogata, "Modern Control Engineering" Prentice Hall of India, Fifth edition, 2010.

6 Brian D. O. Anderson, John Barratt Moore, "Optimal Control" Prentice Hall, 1990.

7 Stefani, Shahian, Savant &Hostetter, "Design of feedback control systems," Oxford University Press, 2002.

8 Stanley M. Shinners, "Modern Control System Theory & Design,"

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PST02	Power System Optimization Techniques	3	0	0	3	50	50	100

Prerequisite: Nil

Objectives

- To have knowledge on optimization techniques applied to power systems.
- To understand the different evolutionary computation techniques and multi objective optimization and their applications in power systems.

UNIT – I **FUNDAMENTALS OF OPTIMIZATION** 9

Definition-Classification of optimization problems-Unconstrained and Constrained optimization-Optimality conditions-Classical Optimization techniques (Linear and non linear programming, Quadratic programming, Mixed integer programming)-Intelligent Search methods (Optimization neural network, Evolutionary algorithms, Tabu search, Particle swarm optimization, Application of fuzzy set theory).

UNIT - II **EVOLUTIONARY COMPUTATION TECHNIQUES** 9

Evolution in nature-Fundamentals of Evolutionary algorithms-Working Principles of Genetic Algorithm- Evolutionary Strategy and Evolutionary Programming-Genetic Operators-Selection, Crossover and Mutation-Issues in GA implementation- GA based Economic Dispatch solution-Fuzzy Economic Dispatch including losses- Tabu search algorithm for unit commitment problem-GA for unit commitment-GA based Optimal power flow- GA based state estimation.

UNIT - III **PARTICLE SWARM OPTIMIZATION** 9

Fundamental principle-Velocity Updating-Advanced operators-Parameter selection-Hybrid approaches (Hybrid of GA and PSO, Hybrid of EP and PSO) -Binary, discrete and combinatorial PSO-Implementation issues-Convergence issues- PSO based OPF problem and unit commitment-PSO for reactive power and voltage control-PSO for power system reliability and security.

UNIT - IV **ADVANCED OPTIMIZATION METHODS** 9

Simulated annealing algorithm-Tabu search algorithm-SA and TS for unit commitment-Ant colony optimization- Bacteria Foraging optimization.

UNIT - V **MULTI OBJECTIVE OPTIMIZATION** 9

Concept of paretooptimality-Conventional approaches for MOOP-Multi objective GA-Fitness assignment-Sharing function-Economic Emission dispatch using MOGA-Multiobjective PSO (Dynamic neighbourhood PSO, Vector evaluated PSO) – Multiobjective OPF problem.

Lecture: 45, TOTAL: 45

COURSE OUTCOMES(COS)

CO1: Will be able to know the basic ANN architectures, algorithms and their limitations.

CO2: Also will be able to know the different operations on the fuzzy sets.

CO3: Will be competent to use hybrid control schemes and P.S.O.

CO4: Will be knowledgeable to use Fuzzy logic for modeling and control of non-linear systems.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	L	PSO1	PSO2	PSO3
CO1	3	3	3	3	2		2					1	3	3	2
CO2	3	3	2	3	2							1	3	3	2
CO3	3	3	2	3	2							1	3	3	2
CO4	2	3	3	3	3							1	3	3	2

REFERENCE BOOK(s) :

1 D.P.Kothari and J.S.Dhillon, "Power System Optimization", 2nd Edition, PHI learning private limited, 2010.
2 Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms", John Wiley and Sons, 2008.
3 Kalyanmoy Deb, "Optimization for Engineering Design",Prentice hall of India first edition,1988.
4 Carlos A.CoelloCoello, Gary B.Lamont, David A.VanVeldhuizen, "Evolutionary Algorithms for solving Multi Objective Problems", 2nd Edition, Springer, 2007.
5 SolimanAbdelHady,AbdelAal Hassan Mantawy, "Modern optimization techniques with applications in Electric Power Systems", Springer,2012.
6 JizhongZhu,"Optimization of power system operation",John Wiley and sons Inc publication,2009.
7 KwangY.Lee,MohammedA.ElSharkawi, "Modern heuristic optimization techniques", John Wiley and Sons,2008.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PST03	Computer Aided Power System Analysis	3	1	0	4	50	50	100

Prerequisite: Nil

Objectives
:

- A review of the basic studies in the area of power systems is expected. Improvements that enable the effective use of computers for large power networks is to be highlighted.
- An emphasis of how the power system models are built for different types of studies is to be laid.
- The course will pave the way for a student to incorporate the use of intelligent techniques in the area of power system analysis.

UNIT – I **INTRODUCTION** 12

Importance of basic power system studies (power flow, short circuit and stability) in the planning and operation of power system - distinction between steady state, quasi steady state and transient modelling of power system.

UNIT - II **SPARSITY ORIENTED NETWORK SOLUTION** 12

Solution of network equation - Exploiting sparsity of bus admittance matrix - compact storage, optimal ordering, triangular factorization and solution using the factors - Solution using Gaussian elimination.

UNIT - III **POWER FLOW STUDIES** 12

Power flow model using bus admittance matrix - Fast decoupled power flow method (FDPF) - with voltage controlled buses using sparsity technique - Load flow based on sparsity oriented solution of I = YV - AC/DC power flow analysis using sequential FDPF method - Radial System power flow –Current injection based techniques - Multiarea power flow analysis with tie-line control - Special Purpose Power Flow Studies - Harmonic power flow - three phase load flow –distribution power flow - interactive load flows - contingency analysis - sensitivity analysis.

UNIT - IV **SHORT CIRCUIT STUDIES** 12

Short circuit analysis of a multi-node power system using bus impedance matrix ZBUS - Building algorithm for ZBUS - Algorithm for symmetrical fault analysis using ZBUS - Development of voltage and current equations under unsymmetrical faults using symmetrical components and algorithm for unsymmetrical fault analysis using ZBUS - Use of sparse factors of YBUS for obtaining the columns of ZBUS.

UNIT - V **STABILITY STUDIES** 12

Mathematical model for stability analysis of a multimachines system with exciters and governors - solution of state equation by modified Euler method/4th order R.K. method

Lecture: 45, Tutorial: 15, TOTAL: 60

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

COURSE OUTCOMES(COS)

CO1: Learners are equipped with the power system studies that needed for the transmission system planning.

CO2: Learners will be able to analyse the impact of distributed generators on the performance of distribution system.

CO3: Learners will be able to understand the need for short circuit studies.

CO4: Learners will be able to explain the stability in multi machine.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	2		2					1	3	3	2
CO2	2	3	3	3	2		2					1	3	3	2
CO3	2	3	2	3	2		2					1	3	3	2
CO4	2	3	3	3	2		2					1	3	3	2

REFERENCE BOOK(s) :

1 Stagg G.Wand El- Abiad .A.H Computer Methods in Power System Analysis: McGraw Hill Book Co,1987

2 Pai M.A. Computer Techniques in Power System Analysis Tata McGrawHill,2006.

3 Brown. H.E Solution of Large Networks by Matrix Methods: John Wiley and Sons. 1975

4 Arrillaga .J and Arnold. C.P Computer Modelling of Electrical Power Systems: John Wiley and Sons,2006

5 Kusic.G.LComputer Aided Power System Analysis PHI,1989.

6 Heydt. T Computer Techniques in Power System Analysis 1996.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PST04	Power System Estimation and Security	3	1	0	4	50	50	100

Prerequisite: Nil

Objectives
:

- A review of SCADA, measurement techniques, concept of data transmission and telemetry is expected.
- Algorithms for state estimation and methods of computing the states of the system is to instilled in the needs of the students.
- The requirement of the system to be secure even during contingent conditions is to be explained. Measures that the operator will have to initiate are to be highlighted. The student will be able to incorporate security procedures not only in the design of power systems but also when he attempts to build newer techniques.

UNIT – I **INTRODUCTION** 12

Concept of power system security - factors affecting security - functions of security control - system monitoring, state estimation, security assessment and security enhancement. System Monitoring: Power system control centres: equipment and interfaces - dual computer configuration, organisation and functions - SCADA system.

UNIT – II **DATA ACQUISITION TRANSMISSION AND TELEMETRY** 12

Block diagram of a typical microprocessor based data acquisition system for power systems - analog and digital signal acquisition modules - interface -microprocessor system - software - display devices. Amplitude modulation - frequency modulation -frequency shift keying - modems - PLCC equipment.

UNIT – III **POWER SYSTEM STATE ESTIMATION** 12

Static state estimation : Maximum likelihood weighted least squares estimation algorithm - active and reactive power bus measurements - active and reactive power line flow measurements - line current measurements - bus voltage measurements -measurement redundancy - accuracy and variance of measurements - variance of measurement residuals - detection, identification and suppression of bad measurements. Computational aspects - approximations to reduce computations - external system equivalencing -fast decoupled state estimation - state estimation using d.c. model of power system. Weighted least absolute value state estimation - comparison with WLSE. Network observability - psuedo measurements - virtual measurements. Stability and robustness of estimation algorithms. tracking state estimation : algorithm - computational aspects.

UNIT – IV **SECURITY ASSESSMENT** 12

Classification of security states : Normal, alert, contingency, emergency and restorative modes. Network equivalent for external system. Contingency analysis :a.c., lineariseda.c. and linearisedd.c. models of power systems for security assessment - line outage distribution factors and generation shift factors for d.c. and lineariseda.c. models - single contingency analysis using these factors - double line outage analysis techniques using bus impedance matrix and factors of bus admittance matrix. Fast contingency algorithms for nonlinear a.c. models. Contingency ranking, security indices.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

UNIT – V **SECURITY ENHANCEMENT** 12

Correcting the generator dispatch for security enhancement using linearisedd.c. models - methods using sensitivity factors - compensated factors - optimisation methods. Emergency and restorative control procedures.

Lecture: 45, Tutorial: 15 TOTAL: 60

COURSE OUTCOMES (COs)

CO1: Learners will be able to understand system load variations and get an overview of power system operations.

CO2: This course gives knowledge about various system components and communication protocols of SCADA system and its applications

CO3: Learners will be able to analyze power system security.

CO4: Learners will be exposed to power system state estimation.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	2	2	1		2					2	2	3	1
CO2	2	3	3	3	3	1	2					1	3	3	2
CO3	2	3	3	3	3	1	2					1	2	3	2
CO4	2	3	3	2	3	1	2					1	2	3	2

REFERENCE BOOK(s) :

1 Wood and WollenbergPower generation, operation and control John Wiley and Sons,1996.

2 Mahalanabis, Kothari and AhsonComputer aided power system analysis and control Tata McGraw Hill,1991

3 Kusic .G.L Computer aided power system analysis Prentice Hall of India,1989.

4 Murty P.S.R Power system operation and control Tata McGraw Hill. 1984

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PST05	Mathematics For Electrical Engineers	3	1	0	4	50	50	100

Prerequisite: Nil

Objectives:

- To develop the ability to apply the concepts of Matrix theory and linear programming in Electrical Engineering problems.
- To achieve an understanding of the basic concepts of one dimensional random variables and apply in electrical engineering problems.
- To familiarize the students in calculus of variations and solve problems using Fourier transforms associated with engineering applications.

UNIT – I **MATRIX THEORY** 12

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

UNIT - II **CALCULUS OF VARIATIONS** 12

Concept of variation and its properties – Euler"s equation – Functional dependant on first and higher order derivatives – Functionalsdependant 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** 12

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** 12

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

UNIT - V **FOURIER SERIES** 12

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.

Lecture: 45, Tutorial: 15, TOTAL: 60

COURSE OUTCOMES (COs)

After completing this course, the student will be able to:

CO1: Apply various methods in matrix theory to solve system of linear equations.

CO2: Compute maxima and minima of a functional that occur in various branches of engineering disciplines.

CO3: Imbibe the knowledge of random variables which helps to understand the various probability distributions

CO4: Formulate and find optimal solution in the real life optimizing/ allocation/assignment problems involving conditions and resource constraints.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

	Programme Outcomes												Programme Specific Outcomes		
	a	B	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2	2	3	2		1					2	2	2	1
CO2	3	3	3	3	2	1	1					2	3	2	1
CO3	2	2	2	2	2		2					1	2	2	1
CO4	3	3	2	2	2	1	1					1	3	3	1

REFERENCE BOOK(s) :

1 Richard Bronson, "Matrix Operation", Schaum"s outline series, 2nd Edition, McGraw Hill, 2011.

2 Gupta, A.S., Calculus of Variations with Applications, Prentice Hall of India Pvt. Ltd., New Delhi, 1997

3 Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.

4 Taha, H.A., "Operations Research, An introduction", 10th edition, Pearson education, New Delhi, 2010.

5 Andrews L.C. and Phillips R.L., Mathematical Techniques for Engineers and Scientists, Prentice Hall of India Pvt.Ltd., New Delhi, 2005.

6 Elsgolts, L., Differential Equations and the Calculus of Variations, MIR Publishers, Moscow, 1973.

7 Grewal, B.S., Higher Engineering Mathematics, 42nd edition, Khanna Publishers, 2012.

8 O'Neil, P.V., Advanced Engineering Mathematics, Thomson Asia Pvt. Ltd., Singapore, 2003.

9 Johnson R. A. and Gupta C. B., "Miller & Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PSP07	Computer Aided Power System Analysis Laboratory –I	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:

- To have hands on experience on various system studies and different techniques used for system planning. Software packages.
- To perform the dynamic analysis of power system.

List of Experiments:

1. Develop a program for Power flow analysis by Newton-Raphson method
2. Develop a program for load flow by Fast Decoupled method.
3. Develop a program for WLS linear state estimation.
4. Develop a program for WLS Non –linear state estimation
5. Develop a program for DC load flow based WLS Sequential State Estimation.
6. Transient stability analysis of single machine-infinite bus system using classical machine model.
7. Contingency analysis: Generator shift factors and line outage distribution factors
8. Develop a program for solving Unit commitment problem: Priority-list schemes and dynamic programming
9. Fault analysis in power system using matrix method
10. Simulation of variable speed wind energy conversion system- DFIG
11. Simulation of variable speed wind energy conversion system- PMSG

Practical: 45

COURSE OUTCOMES(COS)

CO1: Learners will be able to analyze the power flow using Newton-Raphson method and Fast decoupled method

CO2: Learners will be able to perform contingency analysis & economic dispatch

CO3: Learners will be able to simulate the variable speed wind energy system

CO4: Learners will be able to simulate the transient stability

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	2	1					2	3	3	2
CO2	3	3	2	3	3	2	1					2	3	3	2
CO3	2	3	3	2	2	1	1					1	2	3	1
CO4	2	3	3	2	2	1	1					1	2	3	1

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

(PROFESSIONAL ELECTIVE-I)

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
115PSE06	Wind and Solar Energy Systems	3	0	0	3	50	50	100

Prerequisite: Nil

Objectives
:

- To educate the students scientifically the new developments in wind and solar energy systems.
- To emphasize the significant influence of wind and solar energy in power system.

UNIT – I **INTRODUCTION** 9

Recent trends in energy consumption - World energy scenario - Energy sources and their availability - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies.

UNIT - II **WIND ENERGY CONVERSION SYSTEMS** 9

Basic principle of wind energy conversion - nature of wind - Wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS - Analysis of different wind power generators - IG - PMSG - DFIG – SEIG.

UNIT - III **GRID CONNECTED WIND ENERGY SYSTEMS** 9

Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Systems for Feeding into the Grid - Induction Generators for Direct Grid Coupling - Asynchronous Generators in Static Cascades - Synchronous Generators Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement.

UNIT - IV **SOLAR ENERGY CONVERSION SYSTEMS** 9

Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics -PV arrays - Electrical storage with batteries - Switching devices for solar energy conversion Grid connection Issues - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing.

PV Applications: Stand alone inverters - Charge controllers - Water pumping, audio visual equipments, street lighting - analysis of PV systems.

UNIT - V **OPERATION OF POWER SYSTEM WITH WIND AND SOLAR ENERGY SYSTEMS** 9

Interface requirement – synchronizing with grid – operating limit – energy storage and load scheduling – utility resource planning – electrical performance – voltage, current and power efficiency – component design for maximum efficiency – static bus impedance and voltage regulation – quality of power – renewable capacity limit – Plant economy.

Lecture: 45, TOTAL: 45

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

COURSE OUTCOMES(COS)

CO1: Ability to design grid connected/standalone renewable energy system employing embedded energy storage and MPPT strategy.

CO2: Students will develop more understanding on solar energy storage systems

CO3: Students will develop basic knowledge on standalone PV system

CO4: Students will attain knowledge on the basic concepts of Wind energy conversion system

	Programme Outcomes												Programme Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	3	3	3	2	2					2	3	3	3
CO2	2	3	3	3	3	2	2					2	3	3	3
CO3	2	3	3	3	3	2	2					2	3	3	2
CO4	2	3	3	3	3	2	2					2	3	3	2

REFERENCE BOOK(s) :

1 Thomas Ackermann, "Wind Power in Power Systems", John Wiley & Sons, Ltd, 2005.

2 Mukund R. Patel, "Wind and Solar Power Systems", CRC Press, 1999.

3 Muhammed H. Rashid, "Power Electronics Handbook", Academic Press, Second edition,2006.

4 Rao. S. &Parulekar, "Energy Technology", Khanna publishers, Fourth edition, 2005.

5 Rai ,G.D., "Non- conventional resources of energy", Khanna publishers ,Fourth edition , 2010.

6 Bansal N K, Kleeman and Meliss, "Renewable energy sources and conversion Techniques", Tata McGraw hill, 1990.

7 B.H.Khan, "Non-Conventional Energy Resources", Tata McGraw Hills, Second edition, 2009.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215PST01	Reactive Power Compensation and Management	3	1	0	4	50	50	100

Objectives:

1. To improve the knowledge in power system using Reactive Power Compensation
2. To describe the modeling of Line and Load compensation and compensating devices
3. To understand the fundamental concepts of Reactive power coordination, Power Quality,and reactive power management in Domestic and Industrial Sectors.

UNIT – I THEORY OF LOAD COMPENSATION **12**

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

UNIT - II STEADY – STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEMS **12**

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples
Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation –compensation using synchronous condensers – examples.

UNIT - III REACTIVE POWER COORDINATION **12**

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences.

UNIT - IV DEMAND SIDE MANAGEMENT **12**

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels.
Distribution side Reactive power Management: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks.

UNIT - V USER SIDE REACTIVE POWER MANAGEMENT 12

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations.
Reactive power management in electric traction systems and arc furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements –remedial measures –power factor of an arc furnace.

Lecture: 45, Tutorial: 15, TOTAL: 60

COURSE OUTCOMES (COS):

CO1: Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
CO2: Observe various compensation methods in transmission lines
CO3: Construct model for reactive power coordination
CO4: Distinguish demand side reactive power management & user side reactive power management

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	1	1					1	2	3	1
CO2	2	3	3	3	2	1	1					1	2	3	1
CO3	2	2	2	2	3	1	1					1	2	3	1
CO4	2	3	2	3	2	1	1					1	2	3	1

REFERENCE BOOKS :

1 T.J.E.Miller, Reactive power control in Electric power systems, John Wiley and Sons, 1982
2 D.M. Tagare, Reactive power Management, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3 Wolfgang Hofmann, JurgenSchlabbach, Wolfgang Just, Reactive Power Compensation: A Practical Guide, Wiley, April, 2012

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215PST02	Power System Dynamics and Stability	3	1	0	4	50	50	100

Objectives:

1. To impart knowledge on dynamic modeling of a synchronous machine in detail
2. To describe the modeling of excitation and speed governing system in detail.
3. To understand the fundamental concepts of stability of dynamic systems and its classification
4. To understand and enhance small signal stability problem of power systems.

UNIT – I SYNCHRONOUS MACHINE MODELLING 12

Synchronous Machine - Physical Description - Mathematical Description of a Synchronous Machine - Basic equations of a synchronous machine - stator circuit equations, stator self, stator mutual and stator to rotor mutual inductances - dq0 Transformation - Per Unit Representation - Equivalent Circuits for direct and quadrature axes - Steady-state Analysis - Steady-state equivalent circuit, Computation of steady-state values.
Equations of Motion - Swing Equation, H-constant calculation - Representation in system studies - Synchronous Machine Representation in Stability Studies - Simplified model with amortisseurs neglected: - classical model with amortisseur windings neglected.

UNIT – II MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS 12

Excitation System Modeling - Excitation System Requirements - Types of Excitation System - Rotating Rectifier and Potential-source controlled-rectifier systems: hardware block diagram and IEEE(1992) Type ST1A block diagram.
Turbine and Governing System Modeling: Functional Block Diagram of Power Generation and Control - Schematic of a hydroelectric plant - classical transfer function of a hydraulic turbine (no derivation) - special characteristic of hydraulic turbine - electrical analogue of hydraulic turbine
Governor for Hydraulic Turbine - Requirement for a transient droop, Block diagram of governor with transient droop compensation - Steam turbine modeling: Single reheat tandem compounded type only and IEEE block diagram for dynamic simulation; geneneric speed-governing system model for normal speed/load control function.

UNIT - III SMALL-SIGNAL STABILITY ANALYSIS WITH AND WITHOUT CONTROLLERS 12

Classification of Stability - Basic Concepts and Definitions: Rotor angle stability - Fundamental Concepts of Stability of Dynamic Systems: State-space representation - stability of dynamic system - Linearisation, Eigenproperties of the state matrix - eigenvalue and stability - Single-Machine Infinitie Bus (SMIB) Configuration: Classical Machine Model stability analysis with numerical example - Effect of field flux variation on system stability: analysis

with numerical example.
Effects Of Excitation System - analysis of effect of AVR on synchronizing and damping components using a numerical example - Multi-Machine Configuration - Equations in a common reference frame - Formation of system state matrix for a two-machine system with classical models for synchronous machines, illustration of stability analysis using a numerical example.

UNIT - IV TRANSIENT STABILITY ANALYSIS **12**

Introduction - Factors influencing transient stability – Review of Numerical Integration Methods - Simulation of Power System Dynamic response: Structure of Power system Model, Synchronous machine representation - Thevenin's and Norton's equivalent circuits, Excitation system representation, Transmission network and load representation, Overall system equations and their solution: Partitioned - explicit and Simultaneous-implicit approaches, treatment of discontinuities, Simplified Transient Stability Simulation using simultaneous-implicit

UNIT - V INSTABILITY ANALYSIS **12**

Small signal angle instability (sub-synchronous frequency oscillations): analysis and counter-measures. Transient Instability: Analysis using digital simulation and energy function method-Transient stability controller- Introduction to voltage Instability- Analysis of voltage Instability.

Lecture: 45, Tutorial: 15, TOTAL: 60

COURSE OUTCOMES(COS)
CO1: Learners will be able to understand the modeling of excitation and speed governing system for stability analysis.
CO2: Learners will be able to understand on dynamic modelling of synchronous machine.
CO3: Learners will understand the enhancement of small signal stability.
CO4: Learners will understand the significance about small signal stability analysis with controllers.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	1					1	2	2	1
CO2	2	3	3	3	2	2	1					1	2	2	1
CO3	2	3	2	2	2	2	1					1	2	2	1
CO4	2	3	2	2	2	2	1					1	2	2	1

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

REFERENCE BOOKS :

1 P. S. Kundur, "Power System Stability and Control", McGraw-Hill, 2004.
2 K.R.Padiyar, "Power System Dynamics Stability & Control", BS Publications, Hyderabad, 2002.
3 P.M Anderson and A.A Fouad, "Power System Control and Stability", Iowa State University Press, Ames, Iowa, 1978
4 Peter W.Sauer&M.A.Pai, "Power System Dynamics & Stability", Pearson Education, 2002.
5 IEEE Committee Report, "Dynamic Models for Steam and Hydro Turbines in Power System Studies," IEEE Transactions, Vol.PAS-92, pp 1904-1915, November / December 1973

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

PROFESSONAL ELECTIVES - II

Course code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215PSE05	Power Quality Management	3	0	0	3	50	50	100

Objectives:

1. To understand the various power quality issues.
2. To understand the concept of power and power factor in single phase and three phase systems supplying non linear loads
3. To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
4. To understand the active compensation techniques used for power factor correction.
5. To understand the active compensation techniques used for load voltage regulation.

UNIT – I INTRODUCTION 9

Definitions – Power quality, Voltage quality – Power quality issues : Short duration voltage variations, Long duration voltage variations, Transients, Waveform distortion, Voltage imbalance, Voltage fluctuation, Power frequency variations, low power factor – Sources and Effects of power quality problems – Power quality terms – Power quality and Electro Magnetic Compatibility (EMC) Standards.

UNIT – II SHORT INTERRUPTIONS & LONG INTERRUPTIONS 9

Introduction – Origin of short interruptions : Voltage magnitude events due to re-closing, Voltage during the interruption – Monitoring of short interruptions –Influence on induction motors, Synchronous motors, Adjustable speed drives, Electronic equipments – Single phase tripping : Voltage during fault and post fault period, Current during fault period – Prediction of short Interruptions. Definition – Failure, Outage, Interruption – Origin of interruptions – Causes of long interruptions – Principles of regulating the voltage – Voltage regulating devices, Applications : Utility side, End-User side –Reliability evaluation – Cost of interruptions.

UNIT - III VOLTAGE SAG & TRANSIENTS 9

Introduction – Definition – Magnitude, Duration – Causes of Voltage Sag – Three Phase Unbalance – Phase angle jumps – Load influence on voltage sags on Adjustable speed drives, Power electronics loads, Sensitive loads - Stochastic assessment of voltage sags - Overview of mitigation methods. Definition – Power system transient model – Principles of over voltage protection - Types and causes of transients – Devices for over voltage protection - Capacitor switching transients –Lightning transients – Transients from load switching.

UNIT – IV WAVEFORM DISTORTION, WIRING AND GROUNDING **9**

Introduction – Definition and terms – Harmonics, Harmonics indices, Inter harmonics, Notching – Voltage Vs Current distortion – Harmonics Vs Transients – Sources and effects of harmonic distortion – System response characteristics – Principles of controlling harmonics – Standards and limitation - Definitions and terms – Reasons for grounding –National Electrical Code (NEC) grounding requirements – Utility Power system grounding –End-User power system grounding – Wiring and grounding problems.

UNIT - V POWER QUALITY SOLUTIONS **9**

Introduction – Power quality monitoring : Need for power quality monitoring, Evolution of power quality monitoring, Deregulation effect on power quality monitoring – Power factor improvement – Brief introduction to power quality measurement equipments and power conditioning equipments – Planning, Conducting and Analyzing power quality survey – Mitigation and control techniques - Active Filters for Harmonic Reduction

Lecture: 45, TOTAL: 45

COURSE OUTCOMES (COS)

CO1:To study various methods of power quality monitoring and the production of voltages sags.
CO2:To Study the interruptions types and its influence in various components.
CO3:To Study the Effects of harmonics on various equipment's.
CO4:Understand power quality monitoring and classification techniques.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	1	3	2	2	1	1	1					1	2	2	1
CO2	1	3	3	3	2	1	1					1	3	3	2
CO3	1	3	3	3	2	1	1					1	3	3	2
CO4	1	3	2	2	1	1	1					1	2	2	1

REFERENCE BOOKS :

1 Roger C.Dugan, Mark F. McGranaghanandH.WayneBeaty, "Electrical Power Systems Quality", McGraw-Hill, New York, 2nd Edition, 2002.
2 Barry W.Kennedy, "Power Quality Primer", McGraw-Hill, New York, 2000.
3 Sankaran.C, "Power Quality", CRC Press, Washington, D.C., 2002
4 Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000.
5 Arrillaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley & Sons Ltd., England, 2000
6 Short.T.A., "Distribution Reliability and Power Quality", CRC Press Taylor and Francis Group, 2006.

Course code	Course Title	Hours/week			Credits	Maximum Marks		
215PSE12	Power Electronics for Renewable Energy Systems	L	T	P	C	CA	EA	Total
		3	0	0	3	50	50	100

Objectives:

1. To Provide knowledge about the stand alone and grid connected renewable energy systems.
2. To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
3. To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
4. To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
5. To develop maximum power point tracking algorithms.

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 Universal Operation of Small/Medium-Sized Renewable Energy Systems 9

Distributed Power Generation Systems : Single-Stage Photovoltaic Systems , Small/Medium-Sized Wind Turbine Systems , Overview of the Control Structure , Control of Power Converters for Grid-Interactive Distributed Power Generation Systems , Droop Control , Power Control in Microgrids, Control Design Parameters , Harmonic Compensation , Voltage Support at Local Loads Level, Reactive Power Capability , Voltage Support at Electric Power System Area.

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. Recent Developments in Multilevel Inverter-Based PV Systems.

Wind: three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters. Field-Oriented Control of an AC–DC Machine-Side Converter , Stator Current Controller Design, Direct Torque Control with Space Vector Modulation , Machine Stator Flux Controller Design , Voltage-Oriented Control of an AC–DC Grid-Side Converter ,Line Current Controllers of an AC–DC Grid-Side Converter, Direct Power Control with Space Vector Modulation of an AC–DC Grid-Side Converter ,
Line Power Controllers of an AC–DC Grid-Side Converter DC-Link Voltage Controller for an AC–DC Converter.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

UNIT - IV **ANALYSIS OF WIND AND PV SYSTEMS** **9**

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

UNIT - V **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).

Lecture: 45, TOTAL: 45

COURSE OUTCOMES(COS)

CO1: Ability to design grid connected/standalone renewable energy system

CO2: Ability to employing embedded energy storage and MPPT strategy.

CO3:Ability to analysis of wind and PV system

CO4:Ability to explain the hybrid renewable energy systems

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	2					2	3	3	2
CO2	2	3	3	3	3	2	2					2	3	3	2
CO3	2	2	3	2	3	1	2					2	3	3	1
CO4	2	2	3	2	3	1	2					2	3	3	1

REFERENCE BOOKS :

1 S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electricaal 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.

4 Rai. G.D," Solar energy utilization", Khanna publishes, 1993.

5 Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.

6 B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

7 Haitham Abu-Rub, Mariusz Malinowski and Kamal Al-HaddadPower electronics for renewable Energy systems, Transportation and Industrial Applications, publication of IEEE Press and John Wiley & Sons Ltd ,2014.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
215PSP08	Advanced Power System Simulation Laboratory	0	0	4	2	50	50	100

Objectives:

1. To analyze the effect of FACTS controllers by performing steady state analysis.
2. To have hands on experience on different wind energy conversion technologies

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. Simulation of variable speed wind energy conversion system- DFIG
8. Simulation 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.

PRACTICAL: 60, TOTAL : 60

COURSE OUTCOMES (COS)

CO1: Students are able to gain Hands on experience on various power systems dynamic studies using own program and validation of results using software packages.
CO2: Learners will be able to perform load flow analysis and transient analysis.
CO3: Learners will be able to simulate the variable speed wind energy system.
CO4: Learners will be able to design the filter for mitigating harmonics.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	2					2	3	3	2
CO2	2	3	3	3	3	2	2					2	3	3	2
CO3	2	3	3	3	3	2	2					2	3	3	2
CO4	2	3	3	2	2	2	2					2	3	3	1

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315PST01	EHV Power Transmission	3	0	0	3	50	50	100

Objectives:

- To learn the basic knowledge regarding activation function, learning rules and various neural networks.
- To understand the knowledge of crisp set, fuzzy set and Fuzzy logic controllers
- To apply the Genetic algorithms in the tuning of controllers
- To design controllers using Simulation Software fuzzy logic toolbox & NN tool box.

UNIT – I INTRODUCTION 09

Standard Transmission Voltages – Average Values of Line Parameters – Power Handling Capacity and Line Loss – Costs of Transmission Lines and Equipment – Mechanical Considerations in Line Performance.

UNIT - II CALCULATION OF LINE PARAMETERS 09

Calculation of Resistance, Inductance and Capacitance – Calculation of sequence inductances and capacitances – Line parameters for Modes of propagation.

UNIT - III VOLTAGE GRADIENTS OF CONDUCTORS 09

Charge-Potential Relations for Multi-conductor lines – Surface Voltage Gradient on Conductors – Gradient Factors and their use – Distribution of Voltage Gradient on Sub conductors of Bundle - Voltage Gradients on Conductors in the Presence of Ground Wires on Towers.

UNIT - IV CORONA EFFECTS 09

Power losses and audible losses : I^2R Loss and Corona Loss -Attenuation of Traveling Waves Due to Corona Loss - Audible Noise Generation and Characteristics - Limits for Audible Noise - Day-Night Equivalent Noise Level. Radio Interference : corona pulse generation and properties - Limits for Radio Interference Fields - The CIGRE Formula - The RI Excitation Function -Measurement of RI, RIV and Excitation Function - Design of Filter.

UNIT – V ELECTROSTATIC FIELD OF EHV LINES 09

Capacitance of Long Object - Calculation of Electrostatic Field of AC Lines Effect of High Field on Humans, Animals, and Plants - Meters and Measurement of Electrostatic Fields - Electrostatic Induction in Unenergised Circuit of a D/C Line - Induced Voltages in Insulated Ground Wires - Electromagnetic Interference.

Lecture: 45, TOTAL: 45 HRS

Course Outcomes(Cos):

CO1	Students will have knowledge on General aspects and necessity of extra high voltage(EHVAC) transmission,
CO2	Students will have knowledge on Advantages and disadvantages of EHVAC
CO3	Students able to know the Concepts of voltage gradient, effects of corona, electro static field calculations,
CO4	Students will have knowledge on Theory of travelling waves and voltage control of EHVAC transmission

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	1	2	2	2	2	1	1					1	2	2	1
CO2	1	2	2	2	2	1	1					1	2	2	1
CO3	2	3	3	2	2	1	1					1	2	3	1
CO4	2	3	3	2	2	1	1					1	2	3	1

REFERENCE BOOKS :

1 Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Pvt. Ltd., 1990, Second Edition.

2 TuranGonen: Electric Power Transmission System Engineering Analysis and Design, McGraw Hill.

3 A Chakraborti, D.P. Kothari and A.K. Mukhopadyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H, 1999.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315PSP01	Project Work (Phase – I)	0	0	12	6	50	50	100

Objectives:

To enable the students to do a project involving some design and fabrication work.

Every project work shall have a Guide who is a member of the faculty. Twelve periods per week shall be allotted in the time table for this important activity and this time shall be utilized by the students to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present in periodical seminars or viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature – survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation is to be carried out as specified in the guidelines to be issued from time to time.

Course Outcomes:

CO1	Identification of real time problems.
CO2	Awareness of design methodologies and its implementation.
CO3	Implementing advanced simulation software techniques.
CO4	Able to produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO2	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO3	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO4	2	3	3	3	3	2	3	1	2	2	3	2	3	3	2

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

PROFESSIONAL ELECTIVE-V

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315PSE06	Power System Instrumentation	3	0	0	3	50	50	100

Objectives:

- To Study about power system instrumentation, different meters and advanced metering infrastructure
- To familiarize the power measurement techniques in different ways.
- To familiarize the high performance computing in power measurements

UNIT – I INTRODUCTION 09

Power generating Station – Thermal, Hydel, Nuclear , Wind – Their functional characteristics as processes, Components of power Grid – interdependency between different blocks, Review of Mechanical, Electrical, Electronics, Thermal, Optical, Pneumatic, fluidics

UNIT - II TRANSMISSION LINES 09

Fibre optics metering measurement: Fiber optics high voltage measurement - Fibre optics high current measurement- Transmission line sag measurement ordinary method, Transmission line sag measurement using triangulation technique.

UNIT - III TARIFF 09

Objective based tariff, Available based tariff, single phase energy meter, three phase energy meter, Digital energy meter. Remote terminal unit (RTU).

UNIT - IV LOCAL DISPATCH CENTRE 09

Data handling – Processing, Logging, Acquisition, A counting, Display and Storage, SCADA, Techniques of Data acquisition at Central Load Dispatch Centers for coordinated control of the grid

UNIT - V COMPUTER CONTROL OF POWER PLANT 09

IS specification: Introduction, Application and Relevancy of IS specification in perspective of power system instrumentation

Lecture: 45, TOTAL: 45 HRS

Course Outcomes:

CO1: Use power system instrument for automatic generation and voltage control in power generation station.
CO2:Able to use signal transmission techniques for specific power system purposes
CO3:Identify instrumentation schemes for monitoring and control
CO4: Apply signal transmission techniques for sharing process information.

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	2	2	1					1	2	3	1
CO2	2	3	3	3	3	2	1					1	2	3	1
CO3	2	3	3	3	3	2	1					1	2	3	1
CO4	2	3	3	3	2	2	1					1	2	3	1

REFERENCE BOOKS

1 Modern Power Station Practice – Vol: C, Vol: D, Per Gamon Press.

2 Principles of Industrial Instrumentation - D Patranabish, TMH, New Delhi

3 B. G. Liptak, Instrument Engineers Handbook, Chilton Book Co. Philadelphia

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415PSP01	Project Work (Phase – II)	0	0	24	12	50	50	100

Objectives:

To enable the students to do a project involving some design and fabrication work.

Every project work shall have a Guide who is a member of the faculty. Twenty Four periods per week shall be allotted in the time table for this important activity and this time shall be utilized by the students to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present in periodical seminars or viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature – survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation is to be carried out as specified in the guidelines to be issued from time to time.

Course Outcomes:

CO1	Identification of real time problems.
CO2	Awareness of design methodologies and its implementation.
CO3	Implementing advanced simulation software techniques.
CO4	Able to produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO2	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO3	2	3	3	3	3	2	3	1	1	1	2	2	3	3	2
CO4	2	3	3	3	3	2	3	1	2	2	3	2	3	3	2

Chairman, Board of Studies
Faculty of Electrical and Electronics Engineering (UG & PG)
Adhiyamaan College of Engineering (Autonomous)
Hosur - 635 109
Krishnagiri (Dt), Tamil Nadu.