Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1201 : Digital Protection of Power System

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Understand evolution of digital relays
2.	Learn the importance of Digital Relays
3.	Apply Mathematical approach towards protection
4.	Develop various Protection algorithms

	Course Contents	**Hours**
Unit 1	• Evolution of digital relays from electromechanical relays • Performance and operational characteristics of digital protection	**6**
Unit 2	• Mathematical background to protection algorithms • Finite difference techniques	6
Unit 3	• Interpolation formulae • Forward, backward and central difference interpolation • Numerical differentiation • Curve fitting and smoothing • Least squares meth	8
Unit 4	• Basic elements of digital protection • Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers • Conversion subsystem: the sampling theorem, signal aliasing • Error, sample and hold circuits, multiplexers, analog to digital conversion • Digital filtering concepts, • The digital relay as a unit consisting of hardware and software	8
Unit 5	• Sinusoidal wave based algorithms • Sample and first derivative (Mann and Morrison) algorithm.	8
Unit 6	• Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm. • Least Squares based algorithms. Differential equation based algorithms.	8

	• Digital Differential Protection of Transformers. • Digital Line Differential Protection.	

Text Books			
1.	A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009		
2.	A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999		
Reference Books			
1.	S. R. Bhide, “Digital Power System Protection” PHI		
2.	“L. P. Singh, “Digital Protection”, John Wiley & Sons Inc		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1202 : Real Time Control of Power System

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Differentiate between P/F and Q/V control loops.
2.	Analyse control loops for time and frequency response .
3.	Understand use of SCADA and DAS for power system monitoring and control.
4.	Apply analytical methods for optimal load dispatch and control and unit commitment.

	Course Contents	**Hours**
Unit 1	Analytical Methods: Modeling & Identification of power system components, Real time data processing, Real time monitoring using phasor measurement.	**6**

Unit 2	Load Frequency Control: Objectives, tie line bias control, flat frequency control, supplementary control, interconnected areas, two area, three area systems, state variable model for single, two, three area cross coupling between control loops (AVR,AGC), Application of modern control theory, Application of Artificial Intelligence, AGC using Kalman method	8
Unit 3	Optimal Control: Generation mix, Optimum economic dispatch, Optimum generation allocation, Solution techniques for optimum power flow such as gradients , Newton's linear programming, Non linear programming methods such as Dommel tinney, EL Abiad-James. Dynamic programming methods. Fuel scheduling using linear programming, hydro solution to hydro thermal scheduling, short range and long range (Dynamic programming solution to hydro thermal scheduling), scheduling problems Kirchmayers method of co-ordinate equation.	8
Unit 4	Reactive power control: Need for adjustable reactive power, excitation control, tap changing transformers, fundamental concepts of series and dynamic shunt compensation, principles of static compensators and applications. Automatic P.F controlling scheme.	6
Unit 5	State estimation: Power system state estimation, Least square estimation of AC networks, estimation of orthogonal decomposition, application of state estimation to power systems.	6
Unit 6	SCADA and DAS: Power system security, contingency analysis, energy control centers, centralized and de-centralized control, SCADA systems, Recent trends on real time operations. Substation automation, remote metering, energy audit Reconfiguration of distribution networks under normal conditions for loss minimization and restoration of distribution system.	8

Text Books	
1.	B.Handschlw , "Real Time Control Of Electric Power System"
2.	Recent Trends In Electric Energy System—J.Nanda And D.P. Kothari

Reference Books	
1.	Computer Aided System Analysis And Control—Mahalanabis Kothari Ahason
2.	Power System Operation And Control—P.S.R.Murthy
3.	Electric Energy System Theory An Introduction—Olle D.Elgerd
4.	Reactive Power Control Of Electric Power System-T.J.E.Miller

Useful Links	
1.	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1213 : Restructured Power Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Describe various types of regulations in power systems.
2.	Identify the need of regulation and deregulation.
3.	Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4.	Identify and give examples of existing electricity markets.
5	Classify different market mechanisms and summarize the role of various entities in the market. PE

	Course Contents	**Hours**
Unit 1	• Fundamentals of restructured system • Market architecture • Load elasticity • Social welfare maximization	**8**
Unit 2	• OPF: Role in vertically integrated systems and in restructured markets • congestion management	8
Unit 3	• Optimal bidding • Risk assessment • Hedging • Transmission pricing • Tracing of power	8
Unit 4	• Ancillary services • Standard market design • Distributed generation in restructured markets	8
Unit 5	• Developments in India • IT applications in restructured markets	6

Unit 6	• Working of restructured power systems • PJM, Recent trends in Restructuring	6

Text Books			
1.	LorrinPhilipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.		
2.	Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002		
Reference Books			
1.	Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.		
2.	Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1223 : Advanced DSP

Teaching Scheme			**Examination Scheme**	
Lectures	03Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	To understand theory of different filters and algorithms
2.	To understand theory of multirate DSP, solve numerical problems and write algorithms
3.	To understand theory of prediction and solution of normal equations
4.	To know applications of DSP at block level.

	Course Contents	**Hours**
Unit 1	Overview of DSP,Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters,IIR filters by impulse invariance, bilinear transformation,FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.	
Unit 2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.	
Unit 3	Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.	
Unit 4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm	
Unit 5	Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation,Parametric Methods for Power Spectrum Estimation, Minimum- Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation.	
Unit 6	Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications	

Text Books

1.	J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2.	N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.

Reference Books			
1.	Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.		
2.	M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.		
3.	S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.		
4.	D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.		

Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1233 : Dynamics of Electrical M/Cs

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Learn Performance characteristics of machine.
2.	To understand the dynamics of the machine.
3.	To understand how to determine stability of machine.
4.	.Learn the synchronous machine analysis.

	Course Contents	**Hours**
Unit 1	• Stability. • Primitive 4 Winding Commutator Machine. Commutator Primitive • Machine. • Complete Voltage Equation of Primitive 4 Winding Commutator • Machine.	6
Unit 2	• Torque Equation. Analysis of Simple DC Machines using the Primitive • Machine Equations. • The Three Phase Induction Motor. Transformed Equations. • Different Reference Frames for Induction Motor Analysis Transfer • Function Formulation	10
Unit 3	• Three Phase Salient Pole Synchronous Machine. • Parks Transformation- Steady State Analysis.	6
Unit 4	• Large Signal Transient. Small Oscillation Equations in State Variable • form • Dynamical Analysis of Interconnected Machines	6
Unit 5	• Large Signal Transient Analysis using Transformed Equations. • DC Generator /DC Motor System.	8
Unit 6	• Alternator /Synchronous Motor System.	4

Text Books				
1.	D.P. Sengupta & J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980			
2.	R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001			
Reference Books				
1.	. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company, 1987			
2.	. I. Boldia & S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992.			
3.	C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967			
Useful Links				
1.				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1243 : Power Apparatus Design

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Study the modelling analysis of rotating machine.
2.	Learning electromagnetic energy conversion
3.	know about rating of machines.
4.	Understand Computer Aided Electrical Machine Design

	Course Contents	**Hours**
Unit 1	• Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings • Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines • Induction machines and synchronous machines • Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling	**8**
Unit 2	• Specific loadings, choice of magnetic and electric loadings Real and apparent flux - densities, temperature rise calculation • Separation of main dimension for DC machines • Induction machines and synchronous machines • Heating and cooling of machines, types of ventilation, continuous and intermittent rating	8
Unit 3	• General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes • Calculation of losses, efficiency and regulation • Forces winding during short circuit	8
Unit 4	• Choice of specific electric and magnetic loadings, efficiency, power factor • Number of slots in stator and rotor	6

	• Elimination of harmonic torques	
Unit 5	• Design of stator and rotor winding, slot leakage flux • Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data	6
Unit 6	• Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions • Introduction to Computer Aided Electrical Machine Design Energy efficient machines	6

Text Books			
1.	Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.		
2.	M.G. Say, "The Performance and Design of A.C. Machines ", Pitman		
Reference Books			
1.	Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1214 : Advanced Microcontroller based Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	understand the architecture of advance microcontrollers
2.	understand the applications of these controllers
3.	get some introduction to FPGA
4.	understand motor control using micro controller

	Course Contents	**Hours**
Unit 1	• Basic Computer Organization • Accumulator based Processes-Architecture • Memory Organization-I/O Organization	**8**
Unit 2	• Micro-Controllers-Intel 8051, • Intel 8056- Registers, Memories • I/O Ports, Serial Communication • Timers, Interrupts, Programming	8
Unit 3	• Intel 8051 – Assembly language programming • Addressing-Operations • Stack & Subroutines • Interrupts-DMA	8
Unit 4	• PIC 16F877- Architecture Programming • Interfacing Memory/ I/O Devices • Serial I/O and data communication	6
Unit 5	• Digital Signal Processor (DSP) • Architecture – Programming • Introduction to FPGA	
Unit 6	• Microcontroller development for motor control applications	6

	• Stepper motor control using micro controller	

Text Books			
1.	John.F.Wakerly: “Microcomputer Architecture and Programming”, John Wiley and Sons 1981		
2.	Ramesh S.Gaonker: “Microprocessor Architecture, Programming and Applications with the 8085”,		
Reference Books			
1.	Raj Kamal: “The Concepts and Features of Microcontrollers”, Wheeler Publishing, 2005		
2.	Kenneth J. Ayala, “The 8051 microcontroller”, Cengage Learning, 2004		
3.	John Morton,” The PIC microcontroller: your personal introductory course”, Elsevier, 2005		
4.	Dogan Ibrahim,” Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series”, Elsevier, 2008		
5.	Microchip datasheets for PIC16F877		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1224 : SCADA systems and Applications

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	understand what is meant by SCADA and its functions
2.	know SCADA communication
3.	get an insight into its application
4.	understand SCADA Communication

	Course Contents	**Hours**
Unit 1	• Introduction to SCADA • Data acquisition systems • Evolution of SCADA • Communication technologies	**8**
Unit 2	• Monitoring and supervisory functions • SCADA applications in Utility Automation • Industries SCADA	6
Unit 3	• Industries SCADA System Components • Schemes- Remote Terminal Unit (RTU) • Intelligent Electronic Devices(IED) • Programmable Logic Controller (PLC) • Communication Network, SCADA Server, SCADA/HMI Systems	8
Unit 4	• SCADA Architecture • Various SCADA architectures, advantages and disadvantages of each system • single unified standard architecture -IEC 61850.	8
Unit 5	• SCADA Communication • various industrial communication technologies • wired and wireless methods and fiber optics • Open standard communication protocols	8
Unit 6	• SCADA Applications: Utility applications • Transmission and Distribution sector operations, monitoring, analysis and • improvement	6

	• Industries - oil, gas and water • Case studies, Implementation, Simulation Exercises	

Text Books			
1.	Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of America Publications,USA,2004		
2.	Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford, UK,2004		
Reference Books			
1.	William T. Shaw, “Cybersecurity for SCADA systems”, PennWell Books, 2006		
2.	David Bailey, Edwin Wright, “Practical SCADA for industry”, Newnes, 2003		
3.	Michael Wiebe, “A guide to utility automation: AMR, SCADA, and IT systems for electric power”, PennWell 1999		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1234 : Power Quality

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonicson system equipment and loads
2.	develop analytical modeling skills needed for modeling and analysis of harmonics innetworks and components
3.	introduce the student to active power factor correction based on static VAR compensators andits control techniques
4.	introduce the student to series and shunt active power filtering techniques for harmonics.

	Course Contents	**Hours**
Unit 1	• Introduction-power quality-voltage quality-overview of power • Quality phenomena classification of power quality issues. • Power quality measures and standards-THD-TIF-DIN-C-message weights. • Flicker factor transient phenomena-occurrence of power quality problems • Power acceptability curves-IEEE guides • Standards and recommended practices.	**5**
Unit 2	• Harmonics-individual and total harmonic distortion • RMS value of a harmonic waveform • Triplex harmonics. Important harmonic introducing devices.SMPS • Three phase power converters-arcing devices saturable devices • Harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.	8
Unit 3	• Modeling of networks and components under non-sinusoidal conditions • Transmission and distribution systems • Shunt capacitors-transformers.Electric machines. • Ground systems loads that cause power quality problems. • Power quality problems created by drives and its impact on drive	6

Unit 4	• Power factor improvement- Passive Compensation. • Passive Filtering.Harmonic Resonance.Impedance Scan Analysis • Active Power Factor Corrected Single Phase Front End • Control Methods for Single Phase APFC. • Three Phase APFC and Control Techniques • PFC based on Bilateral Single Phase and Three Phase Converter	6
Unit 5	• Hamilton-Jacobi-Bellman equation - model reference adaptive systems (MRAS) - Design hypothesis.	8
Unit 6	• Introduction to design method based on the use of Liapunov function. • Design and simulation of variable structure adaptive model following control.	8

Text Books			
1.	G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007		
2.	Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000		
Reference Books			
1.	J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000		
2.	J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1244 : AI Techniques

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues
2.	Understand reasoning for artificial intelligence
3.	Understand fuzzy logic for artificial intelligence
4.	Understand game playing and natural language processing.

	Course Contents	**Hours**
Unit 1	What is AI (Artificial Intelligence)? : The AI Problems, The Underlying Assumption, What are AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate- And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means- Ends Analysis.	**8**
Unit 2	Knowledge Representation Issues: Representations And Mappings, Approaches To Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.	8
Unit 3	Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer Theory	6
Unit 4	Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC	6
Unit 5	Game Playing: Overview, And Example Domain: Overview, MiniMax, Alpha-Beta Cut-off, Refinements, Iterative deepening, The Blocks World, Components Of A Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques. Understanding: What is understanding? What makes it hard? As constraint satisfaction	8

Unit 6	Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.	8

Text Books	
1.	Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.
Reference Books	
1.	Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009.
Useful Links	
1.	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1215 : Power System Transients

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Knowledge of various transients that could occur in power system and their mathematical formulation
2.	Ability to design various protective devices in power system for protecting equipment and personnel
3.	Coordinating the insulation of various equipments in power system
4.	Modelling the power system for transient analysis

	Course Contents	**Hours**
Unit 1	• Fundamental circuit analysis of electrical transients • Laplace Transform method of solving simple Switching transients • Damping circuits -Abnormal switching transients, Three-phase circuits and transients • Computation of power system transients	**8**
Unit 2	• Principle of digital computation – Matrix method of solution • Modal analysis- Z transform- Computation using EMTP • Lightning, switching and temporary over voltages, Lightning • Physical phenomena of lightning.	8
Unit 3	• Interaction between lightning and power system • Influence of tower footing resistance and Earth Resistance • Switching: Short line or kilometric fault • Energizing transients - closing and • re-closing of lines • line dropping, load rejection – over voltages induced by faults	8
Unit 4	• Switching HVDC lineTravelling waves on transmission line • Circuits with distributed Parameters Wave Equation • Reflection, Refraction, Behaviour of Travelling waves at the line terminations	8

	• Lattice Diagrams – Attenuation and Distortion • Multi-conductor system • and Velocity wave	
Unit 5	• Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level • Statistical approach	6
Unit 6	• Protective devices • Protection of system against over voltages • lightning arresters, substation earthling	6

Text Books			
1.	Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991		
Reference Books			
1.			
2.			
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1225 : FACTS and custom Power Devices

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2.	Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM_Inverter based Reactive Power Systems and their controls .
3.	Develop analytical modelling skills needed for modelling and analysis of such Static VAR Systems.
4.	IEEE power quality standards

	Course Contents	**Hours**
Unit 1	• Reactive power flow control in Power Systems • Control of dynamic power unbalances in Power System • Power flow control-Constraints of maximum transmission line loading • Benefits of FACTS Transmission line compensation- Uncompensated line Shunt compensation - Series compensation –Phase angle control. • Reactive power compensation – Shunt and Series compensation principles – Reactive compensation at transmission and distribution level .	**8**
Unit 2	• Static versus passive VAR compensator,Static shunt compensators: SVC and • STATCOM - Operation and control of TSC, TCR and STATCOM Compensator control • Comparison between SVC and STATCOM.	4
Unit 3	• Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR • Operation and Control –Applications • Static series compensation – GCSC,TSSC, TCSC • Static synchronous series compensators and their Control	6
Unit 4	• SSR and its damping Unified Power Flow Controller: Circuit Arrangement • Operation and control of UPFC- Basic Principle of P and Q control • Independent real and reactivepower flow control- Applications.	4

Unit 5	• Introduction to interline power flow controller. • Modeling and analysis of FACTS Controllers Passive filters, active filtering	6
Unit 6	• Voltage swells , sags, flicker, unbalance and mitigation of these problems by power line conditioners • IEEE standards on power quality.	4

Text Books	
1.	K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New AgeInternationalPublishers, 2007
2.	X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control",Springer Verlag, Berlin, 2006
Reference Books	
1.	N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
2.	K.S.Sureshkumar ,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut,2003.
3.	G T Heydt , "Power Quality", McGraw-Hill Professional, 2007.
4.	T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.
Useful Links	
1.	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1235 : Industrial Load Modelling and Control

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	understand the energy demand scenario
2.	understand the modelling of load and its ease to study load demand industrially
3.	know Electricity pricing models
4.	study Reactive power management in Industries

	Course Contents	**Hours**
Unit 1	• Electric Energy Scenario-Demand Side Management-Industrial Load Management • Load Curves-Load Shaping Objectives • Methodologies-Barriers • Classification of Industrial Loads • Continuous and Batch processes -Load Modeling	**8**
Unit 2	• Electricity pricing – Dynamic and spot pricing -Models • Direct load control- Interruptible load control • Bottom up approach- scheduling- Formulation of load Models • Optimization and control algorithms - Case studies	8
Unit 3	• Reactive power management in industries controls-power quality impacts • application of filters Energy saving in industries	6
Unit 4	• Cooling and heating loads • load profiling • Modeling- Cool storage • Types-Control strategies • Optimal operation • Problem formulation- Case studies	8
Unit 5	• Captive power units • Operating and control strategies • Power Pooling- Operation models • Energy banking • Industrial Cogeneration	6

Unit 6	• Selection of Schemes Optimal Operating Strategies • Peak load saving • Constraints Problem formulation- Case study • Integrated Load management for Industries	6

Text Books	
1.	C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,19892
2.	C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986
Reference Books	
1.	Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
2.	H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
3.	I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
4.	IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA
Useful Links	
1.	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1245 : Dynamics of Linear Systems

Teaching Scheme			**Examination Scheme**	
Lectures	03 Hrs/week		CT – 1	15
Tutorials	-- Hrs/week		CT – 2	15
Total Credits	03		TA	10
			ESE	60
			Duration of ESE	02 Hrs 30 Min

Course Outcomes (CO)

Students will be able to:

1.	understand the linear system and its functions
2.	understand observability and controllability
3.	understand the State space representation of discrete systems
4.	understand the stability analysis of linear systems and implement the same in MATLAB

	Course Contents	**Hours**
Unit 1	• State variable representations of systems • transfer function and transfer function matrix • solutions of state equations	**8**
Unit 2	• Observability and controllability • minimal realization of MIMO systems • analysis of linear time varying systems • the concepts of stability	8
Unit 3	• Lyapunov stability analysis • Lyapunov function and its properties • controllability by state variable feedback	8
Unit 4	• Ackerman's Formula - stabilisation by output feedback • asymptotic observers for state measurement • observer design	6
Unit 5	• State space representation of discrete systems • solution of state equations, controllability and observabilty stability • analysis using Lyapunov method	6
Unit 6	• State feedback of linear discrete timesystems • design of observers - MATLAB Exercises	8

Text Books

1.	Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.

2.	K. Ogata, “State Space Analysis of Control Systems”, Prentice Hall Inc., Englewood Cliffs, N.J., 1965.			
Reference Books				
1.	K. Ogata, “Modern Control Engineering, (second edition)” , Prentice Hall Inc., Englewood Cliffs, N.J., 1990			
2.	M.Gopal, “Digital Control and State Variable Methods”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997			
3.	C.T. Chen, “Linear System Theory and Design”, New York: Holt Rinehart and Winston ,1984			
4.	R.C. Dorf, and R. T. “Bishop, Modern Control Systems”, Addison Wesley Longman Inc., 1999			
Useful Links				
1.				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1206 : Mini Project/Industrial Training

Teaching Scheme			**Examination Scheme**	
Lectures	04 Hrs/week		CT – 1	-
Tutorials	-- Hrs/week		CT – 2	-
Total Credits	02		TA	50
			ESE	50
			Duration of ESE	03 Hrs

Course Outcomes (CO)

Students will be able to:

The main aim of this course is to demonstrate the important attributes like critical thinking, creativity, collaborative efforts and communication skills in students. The aim is also to make students aware with the process involved in making product from idea. Not more than five students may carry out the project together. One supervisor from the department shall be assigned as guide to project batch.

The steps involved for completion of project includes, but not limited to:

1. Conceptualization of innovative idea through literature and market survey; sight visits; interaction with community or industry, socio-economic survey etc.
2. Design of product, processes, methods and systems using multidisciplinary knowledge
3. Fabrication of product, development of software, measurement methods etc.
4. Deployment, implementation and demonstration of project.
5. Presentation of project

Course Contents

1. Conceptualization of project theme (during winter vacation)
2. Learning state-of-the-art related to project idea through literature review /survey/visits/interactions (2 weeks)
3. Designing of project theme and selection of components (2weeks)
4. Procurement of components (2 weeks)
5. Assembly and Fabrication of project work (2 weeks)

	6. Testing and modifications (2 weeks) 7. Report writing and conference ready paper based on project work (2 weeks) 8. Presenting project in front of departmental committee		

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1207 : EPS Lab. II

Teaching Scheme			**Examination Scheme**	
Lectures	08 Hrs/week		CT – 1	-
Tutorials	-- Hrs/week		CT – 2	-
Total Credits	04		TA	50
			ESE	50
			Duration of ESE	03 Hrs

Course Outcomes (CO)

Students will be able to:

1.	Understand parameter settings of commercial digital relays
2.	Design protection scheme using digital relays
3.	Asses power quality and identify issues related to deterioration of power quality
4.	Design smart/ micro grid for an organisation.

Course Contents

Minimum 4 experiments on different digital protection schemes
Minimum 2 experiments on finding power quality indicators using power analyser.
Minimum 1 site visit to RES farm
Minimum 1 design experiment on smart grid / micro grid design for commercial / educational / hospital building.
Minimum 1 industrial visit to utility testing facilities.