Government College of Engineering, Karad

(an Autonomous Institute of Government of Maharashtra)

Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Electrical Power Systems

Semester – I (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	PS1101	Power System Analysis	3	-	-	3	3	15	15	10	60	100
2.	PCC	PS1102	Power System Dynamics	3	-	-	3	3	15	15	10	60	100
3.	PEC	PS11*3	Program Elective - I	3	-	-	3	3	15	15	10	60	100
4.	PEC	PS11*4	Program Elective - II	3	-	-	3	3	15	15	10	60	100
5.	MDC	RM1105	Research Methodology	2	-	-	2	2	15	15	10	60	100
6.	PCC	PS1106	Power System Steady State Analysis Lab / Power Systems Dynamic Lab / Renewable Energy Lab	-	-	8	8	4	-	-	50	50	100
7.													
8.	OEC	OE11*8	Open Elective	3	-	-	3	3	15	15	10	60	100
9.	MNC	AU11*9	Audit Course - I	2	-	-	2	Audit	-	-	-	-	-
			Total	19	-	8	27	21	90	90	110	410	700

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (list is provided at the end of structure)

Government College of Engineering, Karad

(an Autonomous Institute of Government of Maharashtra)

Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Electrical Power Systems

Semester – II (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	PS1201	Digital Protection of Power Systems	3	-	-	3	3	15	15	10	60	100
2.	PCC	PS1202	Real Time Control of Power Systems	3	-	-	3	3	15	15	10	60	100
3.	PEC	PS12*3	Program Elective - III	3	-	-	3	3	15	15	10	60	100
4.	PEC	PS12*4	Program Elective – IV	3	-	-	3	3	15	15	10	60	100
5.	PEC	PS12*5	Program Elective - V	3	-	-	3	3	15	15	10	60	100
6.	PCC	PS1206	Power System Protection Lab / Power Quality Lab / AI Lab / PE Applications to PE Lab / Smart Grid Lab	-	-	8	8	4	-	-	50	50	100
7.													
8.	P / S/ IT	PS1208	Mini Project / Industrial Training	-	-	4	4	2	-	-	50	50	100
9.	MNC	AU12*9	Audit Course - II	2	-	-	2	Audit	-	-	-	-	-
			Total	17	-	12	29	21	90	90	110	410	700

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Program Elective / Audit Course / Open Elective (list is provided at the end of structure)

Government College of Engineering, Karad

(an Autonomous Institute of Government of Maharashtra)

Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Electrical Power Systems

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1	P/S/IT	PS1301	Dissertation I	-	-	14	14	07			100	100	200
2	PEC	PS1302	MOOC course (8-12)	-	-	-	-	03	-	-	-	-	-
			Total	-	-	14	14	10	-	-	100	100	200

Note:

1. PS 1302 will be decided by respective Guide in Consultation with Program Coordinator. Course is mandatory is for student and his dissertation phase I will be considered incomplete without this Mandatory MOOC Course.

2. In Case, the course offered online are not completely relevant with the topic of dissertation then any course suggested by NASSCOM on recent technologies can be opted by candidate.

L- Lecture T-Tutorial P-Practical
CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment
CT2- Class Test 2 ESE- End Semester Examination (For Laboratory End Semester performance)

PROGRESSIVE TOTAL CREDITS 42+10 = **52**

Government College of Engineering, Karad

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Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Electrical Power Systems

Semester – IV (w.e.f.: AY 2019-20)

Sr.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	Exam Scheme				
									CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	P / S / IT	PS1401	Dissertation - II	-	-	32	32	16	-	-	100	200	300
			Total	-	-	32	32	16	-	-	100	200	300

TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

Government College of Engineering, Karad

(an Autonomous Institute of Government of Maharashtra)

Scheme of Instructions and Syllabus

Scheme of Instructions for First Year M. Tech. course in Electrical Power Systems

List of Program Elective Courses

Semester - I			Semester - II		
Program Elective - I	Program Elective - II		Program Elective - III	Program Elective - VI	Program Elective - V
PS1113: Renewable Energy Systems	PS1114: Electrical Power Distribution Systems		PS1213: Structured Power Systems	PS1214: Advanced Microcontroller Based Systems	PS1215: Power System Transients
PS1123: Smart Grids	PS1124: Mathematical Methods for Power Engineering		PS1223: Advanced DSP	PS1124: SCADA Systems and Applications	PS1225: FACTs and Custom Power Devices
PS1133: High Power Converters	PS1134: Pulse Width Modulation for PE Converters		PS1233: Dynamics of Electrical M/Cs	PS1234: Power Quality	PS1235: Industrial Load Modeling and Control
PS1143: Wind and Solar Systems	PS1144: Electric and Hybrid Vehicles		PS1243: Power Apparatus Design	PS1244: AI Techniques	PS1245: Dynamics of Linear Systems

List of Open Electives and Audit Courses

Semester - I			Semester - II
Open Electives	Audit Course - I		Audit Course - II
OE1118: Business Analytics	AU1119: Research Paper Writing		AU1219: Constitution of India
OE1128: Industrial Safety	AU1129: Disaster Management		AU1229: Pedagogy Studies
OE1138: Operation Research	AU1139: Sanskrit for Technical Knowledge		AU1239: Stress Management by Yoga
OE1148: Cost Management of Engineering Projects	AU1149: Value Education		AU1249: Personality Development through Life Enlightenment Skills
OE1158: Composite Materials			
OE1168: Waste to Energy			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1101: Power System Analysis

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.	calculate voltage phasors and fault currents at all buses from given data using various methods of analysis
2.	Rank various contingencies according to their severity
3.	Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc
4.	Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

	Course Contents	Hours
Unit 1	• Load flow **:**Overview of Newton-Raphson ,Gauss-Siedel • Fast decoupled methods, convergence properties, sparsity techniques, handling Qmax violations in constant matrix, inclusion in frequency effects	**6**
Unit 2	• Fault Analysis**:** Simultaneous faults • Open conductors faults	8
Unit 3	• Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors • line outage distribution factor, multiple line outages	8
Unit 4	• State Estimation : Sources of errors in measurement • Virtual and Pseudo	6
Unit 5	• Measurement, Observability • Tracking state estimation,	8
Unit 6	• Voltage Stability : Voltage collapse • P-V curve, multiple power flow solution • continuation power flow, optimal multiplies load flow	**6**

Text Books				
1.	J.J. Grainger &W.D.Stevenson, “Power system analysis ”, McGraw Hill ,2003			
2.	L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006			
Reference Books				
1.	A. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000			
2.	G.L. Kusic, “Computer aided power system analysis” ,Prentice Hall India, 1986			
3.	A.J. Wood, “ Power generation, operation and control” , John Wiley, 1994			
4.	P.M. Anderson, “Faulted power system analysis” , IEEE Press , 1995			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1102 : Power System Dynamics

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 modelling of synchronous machine in details system
2.	Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
3.	Carry out stability analysis with and without power system stabilizer (PSS)
4.	Understand the load modeling in power

	Course Contents	Hours
Unit 1	• Synchronous Machines: Per unit systems • Park's Transformation (modified) • Flux-linkage equations.	**8**
Unit 2	• Voltage and current equations • Formulation of State-space equations • Equivalent circuit.	8
Unit 3	• Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines	6
Unit 4	• Small signal model: Introduction to frequency model.	4
Unit 5	• Excitation systems and Philips-Heffron model • PSS Load modeling.	8
Unit 6	• Modeling of Induction Motors • Prime mover controllers.	6

Text Books

1.	P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2.	J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997

Reference Books

1.	P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.

2.	E.W. Kimbark, “Power system stability”, Vol. I & III, John Wiley & Sons, New York 2002			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1113: Renewable Energy 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.	Know about renewable energy
2.	Understand the working of distributed generation system in autonomous/grid connected modes
3.	Know the Impact of Distributed Generation on Power System
4.	Understand Economics of Distributed Generation

	Course Contents	Hours
Unit 1	• Introduction, Distributed vs Central Station Generation • Sources of Energy such as Micro-turbines • Internal Combustion Engines.	**6**
Unit 2	• Introduction to Solar Energy, Wind Energy, Combined Heat and Power • Hydro Energy, Tidal Energy, Wave Energy • Geothermal Energy, Biomass and Fuel Cells.	8
Unit 3	• Power Electronic Interface with the Grid	6
Unit 4	• Impact of Distributed Generation on the Power System • Power Quality Disturbances	8
Unit 5	• Transmission System Operation • Protection of Distributed Generators	8
Unit 6	• Economics of Distributed Generation • Case Studies	6

Text Books

1.	RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011
2.	Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press

Reference Books

1.	Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.

2.	Roger A.Messenger, Jerry Ventre, “Photovoltaic System Engineering”, 3rd Ed, 2010
3.	James F.Manwell, Jon G.McGowan, Anthony L Rogers, “Wind energy explained: Theory Design and Application”, John Wiley and Sons 2nd Ed, 2010

Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1123 : Smart Grid

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.	Appreciate the difference between smart grid & conventional grid
2.	Apply smart metering concepts to industrial and commercial installations
3.	Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4.	Come up with smart grid solutions using modern communication technologies

	Course Contents	Hours
Unit 1	• Introduction to Smart Grid, Evolution of Electric Grid • Concept of Smart Grid, Definitions • Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid	**8**
Unit 2	• Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR) • Outage Management System(OMS) • Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation • Smart Substations, Substation Automation, Feeder Automation .	8
Unit 3	• Geographic Information System(GIS) • Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS) • Phase Measurement Unit(PMU)	6
Unit 4	• Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid. □ Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines • Captive power plants, Integration of renewable energy sources	8
Unit 5	• Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources • Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring Power Quality Audit	6
Unit 6	• Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area • Network (NAN), Wide Area Network (WAN)	8

	• Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, • Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid Broadband over Power line (BPL) • IP based protocols	

Text Books			
1.	Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011		
2.	Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press , 2009		

Reference Books			
1.	JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”, Wiley 2012		
2.	Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press		
3.	A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer		

Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1133: High Power Converter

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 the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems and PWM techniques and the ability to use them properly
2.	Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters
3.	Acquire knowledge of power conditioners and their applications
4.	Ability to design power circuit and protection circuit of PSDs and converters

	Course Contents	Hours
Unit 1	• Power electronic systems • An overview of PSDs, multi-pulse diode rectifier, multi-pulse • SCR rectifier	**6**
Unit 2	• Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, • cascaded • H bridge multilevel inverter.	8
Unit 3	• Diode clamped multilevel inverters, flying capacitor multilevel inverter	8
Unit 4	• PWM current source inverters, • DC to DC switch mode converters	6
Unit 5	• AC voltage controllers : Cyclo-converters, matrix converter, • Power conditioners and UPS.	8
Unit 6	• Design aspects of converters, protection of devices and circuits	6

Text Books

1.	N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”, John Wiley and Sons, 1989
2.	M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994

Reference Books

1.	B. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986
2.	Bin Wu, “High power converters and drives”, IEEE press, Wiley Enter science

Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1143 : Wind and Solar System

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.	Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2.	Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3.	Demonstrate the knowledge of physics of solar power generation and the associated issues
4.	Identify, formulate and solve the problems of energy crises using wind and solar energy

	Course Contents	Hours
Unit 1	• Historical development and current status • characteristics of wind power generation network integration issues	8
Unit 2	• Generators and power electronics for wind turbines, • power quality standards for wind turbines, • Technical regulations for interconnections of wind farm with power systems.	6
Unit 3	• Isolated wind systems, • reactive power and voltage control, • economic aspects.	6
Unit 4	• Impacts on power system dynamics, • power system interconnection	8
Unit 5	• Introduction of solar systems, • merits and demerits, concentrators, various applications.	6
Unit 6	• Solar thermal power generation, • PV power generation, • Energy Storage device. • Designing the solar system for small installations	8

Text Books

1.	Thomas Ackermann, Editor, “Wind power in Power Systems”, John Willy and sons ltd.2005

2.	Siegfried Heier, “Grid integration of wind energy conversion systems”, John Willy and sons ltd., 2006			
Reference Books				
1.	K. Sukhatme and S.P. Sukhatme, “Solar Energy”. Tata MacGraw Hill, Second Edition, 1996			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1114 : Electrical Power Distribution 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 power distribution system
2.	study of Distribution automation and its application in practice
3.	learn SCADA system
4.	Understand difficulties in Implementing Distribution

	Course Contents	Hours
Unit 1	• Distribution of Power, Management, Power Loads, • Load Forecasting Short-term & Long-term, • Power System Loading, Technological Forecasting.	**6**
Unit 2	• Advantages of Distribution Management System (D.M.S.) Distribution Automation: Definition, • Restoration / Reconfiguration of Distribution Network, Different Methods and constraints • Power Factor Correction	8
Unit 3	• Interconnection of Distribution, • Control & Communication Systems, • Remote Metering, • Automatic Meter Reading and its implementation	6
Unit 4	• SCADA: Introduction, Block Diagram, • SCADA Applied To Distribution Automation. • Common Functions of SCADA, • Advantages of Distribution Automation through SCADA	8
Unit 5	• Calculation of Optimum Number of Switches, Capacitors, Optimum Switching vice Placement in Radial, • Distribution Systems, Sectionalizing Switches – Types, Benefits, • Bellman's Optimality Principle, • Remote Terminal Units, • Energy efficiency in electrical distribution & Monitoring	8
Unit 6	• Maintenance of Automated Distribution Systems • Difficulties in Implementing Distribution. • Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI	**8**

	techniques applied to Distribution Automation	

Text Books			
1.	A.S. Pabla, " Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.		
2.	M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi		
Reference Books			
1.	Anthony J Panseni, "Electrical Distribution Engineering", CRC Press		
2.	James Momoh, "Electric Power Distribution, automation, protection & control", CRC Press Course		
Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1124: Mathematical Methods for Power Engineering

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 vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators
2.	To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology
3.	Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4.	Understanding the concept of random variables, functions of random variable and their probability distribution
5	Understand stochastic processes and their classification

	Course Contents	Hours
Unit 1	• Vector spaces, • Linear transformations • Matrix representation of linear transformation	8
Unit 2	• Eigen values and Eigen vectors of linear operator	6
Unit 3	• Linear Programming Problems • Simplex Method • Duality • Non Linear Programming problems	8
Unit 4	• Unconstrained Problems • Search methods • Constrained Problems	6
Unit 5	• Lagrange method • Kuhn-Tucker conditions • Random Variables • Distributions	8
Unit 6	• Independent Random Variables • Marginal and Conditional distributions • Elements of stochastic processes	8

Text Books

1.	Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Edition, PHI, 1992
2.	Erwin Kreyszig, “Introductory Functional Analysis with Applications”, John Wiley & Sons, 2004

Reference Books			
1.	Irwin Miller and Marylees Miller, John E. Freund’s “Mathematical Statistics”, 6th Edn, PHI, 2002		
2.	J. Medhi, “Stochastic Processes”, New Age International, New Delhi., 1994		
3.	A Papoulis, “Probability, Random Variables and Stochastic Processes”, 3rd Edition, McGraw Hill, 2002		
4.	John B Thomas, “An Introduction to Applied Probability and Random Processes”, John Wiley, 2000		
5.	Hillier F S and Liebermann G J, “Introduction to Operations Research”, 7th Edition, McGraw Hill, 2001		
6	Simmons D M, “Non Linear Programming for Operations Research”, PHI, 1975		

Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1134: Pulse Width Modulation for PE Converter

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.	Appreciate importance of PWM techniques
2.	Implement PWM using different strategies
3.	Control CSI and VSI using PWM
4.	Compare performance of converter for different PWM techniques

	Course Contents	Hours
Unit 1	• Modulation of one inverter phase leg • Modulation of single phase • VSI and 3 phase VSI	6
Unit 2	• Zero space vector placement modulation strategies • Losses-Discontinuous modulation • Modulation of CSI	8
Unit 3	• Over modulation of converters • programme modulation strategies	6
Unit 4	• Pulse width modulation for multilevel inverters • Implementation of modulation controller	8
Unit 5	• Continuing developments in modulation as random PWM • PWM for voltage unbalance	8
Unit 6	• Effect of minimum pulse width and dead time	8

Text Books

1.	D. Grahame Holmes, Thomas A. Lipo, “Pulse width modulation of Power Converter: Principles and Practice”, John Wiley & Sons, 03-Oct-2003
2.	Bin Vew, “High Power Converter”, Wiley Publication

Reference Books

1.	Marian K. Kazimicrczuk, “Pulse width modulated dc-dc power converter”, Wiley Publication

Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1144: Electric and Hybrid Vehicles

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 fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2.	Learn electric drive in vehicles / traction.
3.	Understand hybrid traction,
4.	Understand Matching the electric machine and the internal combustion engine

	Course Contents	Hours
Unit 1	• History of hybrid and electric vehicles, • Social and environmental importance of hybrid and electric vehicles • Impact of modern drive-trains on energy supplies • Basics of vehicle performance, vehicle power source characterization Transmission characteristics	8
Unit 2	• Basic concept of hybrid traction, • Introduction to various hybrid drive-train topologies • Power flow control in hybrid drive-train topologies	8
Unit 3	• Basic concept of hybrid traction, • Introduction to various hybrid drive-train topologies	6
Unit 4	• Introduction to electric components used in hybrid and electric vehicles • Configuration and control of DC Motor drives • Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance	8
Unit 5	• Matching the electric machine and the internal combustion engine (ICE) • Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology	8
Unit 6	• Introduction to energy management and their strategies used in hybrid and electric vehicle • Classification of different energy management strategies Comparison of different	6

	energy management strategies Implementation issues of energy strategies			
Text Books				
1.	Electric And Hybrid Electric Vehicles Braking Systems And Nvh Considerations Author Jurgen R K, Publisher - Sae International			
Reference Books				
1.	Eectric And Hybrid Vehicles Design Fundamentals, Author Husain Iqbal			
2	Modern Electric Hybrid Electric and Fuel Cell Vehicles Fundamentals Theory and Design Author Ehsani M.; Gao Yimin ; Emadia A. Crc Press Newyork			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1115: Business Analytics

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 role of business analytics within an organization.
2.	Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3.	To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4.	To become familiar with processes needed to develop, report, and analyze business data.

	Course Contents	Hours
Unit 1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
Unit 2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
Unit 3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	9
Unit 4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation	10

	Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	
Unit 5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
Unit 6	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Text Books	
1.	Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
Reference Books	
1.	Business Analytics by James Evans, persons Education.
Useful Links	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1125: Industrial Safety

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 importance of Industrial Safety
2.	Understand importance of maintenance engineering
3.	Understand Fault tracing
4.	Understand importance of preventive maintenance

	Course Contents	Hours
Unit 1	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8
Unit 2	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	8
Unit 3	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	6
Unit 4	Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	8
Unit 5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities	6

	and its use, definition, need, steps and advantages of preventive maintenance.	
Unit 6	Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance	4

Text Books	
1.	Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2.	Maintenance Engineering, H. P. Garg, S. Chand and Company.

Reference Books	
1.	Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2.	Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Useful Links	

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1135: Operations Research

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.	Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2.	Students should able to apply the concept of non-linear programming
3.	Students should able to carry out sensitivity analysis
4.	Student should able to model the real world problem and simulate it.

	Course Contents	Hours
Unit 1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	8
Unit 2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	8
Unit 3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	6
Unit 4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	8
Unit 5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	8

Text Books

1.	H.A. Taha, Operations Research, An Introduction, PHI, 2008
2.	H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

Reference Books

1.	J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
2.	Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3.	Pannerselvam, Operations Research: Prentice Hall of India 2010

4.	Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1145: Cost Management of Engineering Project

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 importance of Cost Management
2.	Understand importance of Project Management
3.	Understand importance of Cost Analysis
4.	Understand Quantitative techniques for cost management

	Course Contents	Hours
Unit 1	Introduction and Overview of the Strategic Cost Management Process	6
Unit 2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	8
Unit 3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution : conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site : Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process	8
Unit 4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,	6
Unit 5	Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	4
Unit 6	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	6

Text Books

1.	Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi			
2.	Charles T. Horngren and George Foster, Advanced Management Accounting			
Reference Books				
1.	Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting			
2.	Ashish K. Bhattacharya, Principles & Practices of CostAccounting A. H. Wheeler publisher			
3.	N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1155: Composite Materials

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 types of Engineering Materials
2.	Understand Manufacturing of Metal Matrix Composites
3.	Understand Manufacturing of Polymer Matrix Composites
4.	Understand importance of Material Strength

	Course Contents	Hours
Unit 1	INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	8
Unit 2	REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.	4
Unit 3	Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	2
Unit 4	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	6
Unit 5	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	8
Unit 6	Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8

Text Books

1.	Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2.	Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R.

	Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.			
Reference Books				
1.	Hand Book of Composite Materials-ed-Lubin.			
2.	Composite Materials – K.K.Chawla.			
3.	Composite Materials Science and Applications – Deborah D.L. Chung.			
4.	Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi			
Useful Links				

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1165: Waste of Energy

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 importance of Energy from Waste
2.	Understand importance of Biomass
3.	Understand Biomass useful properties.
4.	Understand Biomass conversion processes

	Course Contents	Hours
Unit 1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	8
Unit 2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	8
Unit 3	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	6
Unit 4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	8
Unit 5	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification	4
Unit 6	Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	4

Text Books

1.	Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2.	Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

Reference Books			
1.	Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.		
2.	Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.		
Useful Links			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1106 : Research Methodology

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

Course Outcomes (CO)

Students will be able to:

1.	Understand research problem formulation
2.	Analyse research related information
3.	Follow research ethics
4.	Understand New Developments in IPR

	Course Contents	Hours
Unit 1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	8
Unit 2	Effective literature studies approaches, analysis Plagiarism, Research ethics	4
Unit 3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	6
Unit 4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	8
Unit 5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	6
Unit 6:	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	8

Text Books

1.	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'
2.	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Reference Books			
1.	Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”		
2.	Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”		
3.	Mayall, “Industrial Design”, McGraw Hill, 1992.		
4.	Asimov, “Introduction to Design”, Prentice Hall, 1962.		
5.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.		
6	Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.		
Useful Links			
1.			

Government College of Engineering, Karad

First Year M. Tech in Electrical Power Systems

PS1107:EPS Lab I

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.	Specify ratings of power apparatus based on power system design
2.	Understand interconnection of power system components
3.	Create and simulate power system on computational platform
4.	Interface RES to conventional power system

Course Contents

Minimum 8experiments on suitable computational platform for deep understanding of power system analysis, dynamics and interconnection of RES.

Minimum two experiments on hardware setup to understand use of power electronics in power system.

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				

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				

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	

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.	8
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.	8
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.	8
Unit 4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm	8
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.	6
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	6

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	

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				

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

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				

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			

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	

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	

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.	D. P. Kothari, C S. Indulkar,Power System Transients: A Statistical Approach, PHI		
Useful Links			

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 Age International Publishers, 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	

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				

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.

Government College of Engineering, Karad				
Second Year (Sem-III) M. Tech. Electrical Power Systems				
PS 1301: Dissertation Phase-I				
Laboratory Scheme			**Examination Scheme**	
Practical	14 Hrs/week		**CA**	**100**
Total Credits	**07**		**ESE**	**100**

Course Outcome(CO): After completion of course, students would be able to:	
1	Perform scientific literature survey
2	Write research hypothesis
3	Analyse the problem statement using appropriate modern simulation / modelling tools
4	Plan and budget the technical project by market survey

Course Contents

The Dissertation Work should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. It should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Program and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following:

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey problem definition
- Motivation for study and objectives
- Preliminary design / feasibility / modular approaches
- Report and presentation

Guidelines for Dissertation Phase – I:

- The dissertation may be carried out in-house i.e. department's laboratories and centres OR in industry approved by Program head.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include referred Journals. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, record of continuous progress.

• Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the phase-I work.
List of Submission:

1.	Dissertation report should be prepared using Latex.

Mapping of COs and POs:

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO
CO 1	2	2	1	2	2	2	2	1	2	1		2	1
CO 2	2		1			1		1	2	3	2	2	2
CO 3	2	3	3	3	3		1	1	2	2	1	2	1
CO 4		2		2	2		2	2	2	3	2	3	

1: Light (Low) 2: Moderate (Medium) 3: Substantial (High)

Government College of Engineering, Karad				
Second Year (Sem –III) M. Tech. Electrical Engineering (Electrical Power Systems)				
PS :1302 MOOCs / OPEN COURSE				
Teaching Scheme			**Examination Scheme**	
Lectures	-		CT – 1	-
Tutorials			CT – 2	-
Total Credits	3		TA	-
			ESE	-
			Duration of ESE	

Course Outcomes (CO)	
After completion of course, students would be able to:	

	Course Guidelines	**Hours**
	Online courses available on digital platform like MOOCs/ NPTEL/ Coursera etc during the academic semester will be reviewed and listed by departmental faculty board before start of every semester. Suitable course for registered candidate will be recommended by Guide and Programme Head considering skill sets and knowledge required for dissertation work of the individual candidate (from the list). It shall have minimum 8-12 weeks duration, peer graded assignment and examination to award grade by online course offering agency. The report of course completed with copy of Grade Report shall be submitted to the examination section. In case online course is not available, departmental committee will specially design syllabus for course under self-learning mode and guide will conduct end semester examination to award the grade.	

Government College of Engineering, Karad				
Second Year (Sem-IV) M. Tech. Electrical Power Systems				
PS1401: Dissertation Phase-II				
Laboratory Scheme			**Examination Scheme**	
Practical	32 Hrs/week		**CA**	**100**
Total Credits	**16**		**ESE**	**200**

Course Outcome(CO): After completion of course, students will be able to:	
1	Write technical reports on the research topic of work.
2	Carry out detailed mathematical modelling or experimental validation
3	Draw inferences from the findings and present conclusion.
4	Learn presentation skills for technical paper and report writing

Course Contents

This phase is a continuation of Dissertation work started in semester III. Student has to submit the report in prescribed format. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Program Head and PG coordinator.

The dissertation stage II is based on a report prepared by the students on dissertation topic allotted to him.
It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.

The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – II:

- During phase – II, student is expected to exert on detail design, development verification and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report and presentation. In case of unsatisfactory performance, committee may recommend for extension of work.

List of Submission:

1.	Dissertation report should be prepared using Latex.

PO → CO ↓	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO
CO 1	2	2	2	2	2		1	1	2	2	2	2	2
CO 2	2	3	3	3	3		1	1	2	2	1	2	1
CO 3						1		1	2	3	2	2	2
CO 4	2		1			1		1	2	3	2	2	2

1: Light (Low) 2: Moderate (Medium) 3: Substantial (High)