Government College of Engineering, Karad

(An Autonomous Institute of Government of Maharashtra)

M. Tech. Electrical Engineering - Power Systems

Curriculum Structure

Semester I

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Credits	EXAM SCHEME				
								CT1	CT2	TA / CA	ESE	TOTAL
1	PS101	Advance Engineering Mathematics	3	1	-	4	4	15	15	10	60	100
2	PS102	Modern Power System Analysis and Computer Methods	3	1	-	4	4	15	15	10	60	100
3	PS103	EHVAC	3	1	-	4	4	15	15	10	60	100
4	PS104	Power System Transients	3	1	-	4	4	15	15	10	60	100
5	PS107	Digital Protection	3	-	-	3	3	15	15	10	60	100
6	PS106	Lab Practice-I	-	-	4	4	2	-	-	50	50	100
		Total	15	4	4	23	21	75	75	100	350	600

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)

Government College of Engineering, Karad

(An Autonomous Institute of Government of Maharashtra)

M. Tech. Electrical Engineering - Power Systems

Curriculum Structure

Semester II

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	EXAM SCHEME				
								CT1	CT2	TA / CA	ESE	TOTAL
1	PS201	Power System Dynamics and Stability	3	1	-	4	4	15	15	10	60	100
2	PS202	Real Time Control of Power Systems	3	1	-	4	4	15	15	10	60	100
3	PS203	Power Electronics Applications in Power System	3	1	-	4	4	15	15	10	60	100
4	PS2*4	Elective-I	3	1	-	4	4	15	15	10	60	100
5	PS2*5	Elective-II	3	1	-	4	4	15	15	10	60	100
6	PS206	Lab Practice-II	-	-	4	4	2	-	-	50	50	100
7	PS207	Seminar-I	-	-	2	2	1	-	-	50	-	50
		Total	15	5	6	26	23	75	75	150	350	650

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)

*- Elective- I and Elective- II list is provided at the end of structure.

Government College of Engineering, Karad

(An Autonomous Institute of Government of Maharashtra)

M. Tech. Electrical Engineering - Power Systems

Curriculum Structure

Semester III

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	EXAM SCHEME				
								CT1	CT2	TA/CA	ESE	TOTAL
1	PS301	Seminar II	-	-	2	2	1	-	-	50	-	50
2	PS302	Dissertation Phase I	-	-	20	20	10	-	-	100	-	100
		Total	-	-	22	22	11	-	-	150	-	150

CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment

CT2- Class Test 2 ESE- End Semester Examination (For Laboratory: End Semester Performance)

Government College of Engineering, Karad

(An Autonomous Institute of Government of Maharashtra)

M. Tech. Electrical Engineering - Power Systems

Curriculum Structure

Semester IV

Sr. No.	Course Code	Course Title	L	T	P	Contact Hrs/Wk	Credits	EXAM SCHEME				
								CT1	CT2	TA/CA	ESE	TOTAL
1	PS401	Dissertation Phase II	-	-	30	30	20	-	-	100	200	300
		Total	-	-	30	30	20	-	-	100	200	300

CT1- Class Test 1 TA/CA- Teacher Assessment/Continuous Assessment

CT2- Class Test 2 ESE- End Semester Examination (For Laboratory: End Semester Perform

Government College of Engineering, Karad

(An Autonomous Institute of Government of Maharashtra)

Programme: Electrical Engineering- Power Systems

List of Electives

Elective I	Elective II
Semester - II	**Semester - II**
PS214 Power Quality	**PS215** Optimal Control
PS224 Neural Network and Fuzzy Logic	**PS225** High Voltage Engineering
PS234 Embedded Systems	**PS235** Energy Management and Energy Audit
PS244 Digital Image Processing	**PS245** Power System Deregulation

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS101: Advanced Engineering Mathematics

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	**CT1**	15
Tutorial	1 Hr./week	**CT2**	15
Total Credits	**3+1=4**	**TA**	10
		ESE	60

Course Objectives

1 Knowledge of Mathematics is Sinequanon.
2 To impart sound knowledge of Linear systems.
3 To improve mathematics to use to solve power system problems.

Course Contents		**Hours**
Unit I	Introduction**:** First Basic Problem – Systems of Linear equations - Matrix Notation – The various questions that arise with a system of linear equations. Second Basic Problem – Diagonalization of a square matrix – The various questions that arise with diagonalization. Vector Spaces **:**Vector spaces, Subspaces,Linear combinations and subspaces spanned by a set of vectors, Linear dependence and Linear independence, Spanning Set and Basis, Finite dimensional spaces, Dimension.	07
Unit II	Solutions of Linear Systems: Simple systems, Homogeneous and Nonhomogeneous systems, Gaussian elimination, Null Space and Range, Rank and nullity, Consistency conditions in terms of rank, General Solution of a linear system, Elementary Row and Column operations, Row Reduced Form, Triangular Matrix Factorization. Important Subspaces associated with a matrix: Range and Null space, Rank and Nullity, Rank Nullity theorem, Four Fundamental subspaces,Orientation of the four subspaces	06
Unit III	Orthogonality **:**Inner product, Inner product Spaces, Cauchy – Schwarz inequality, Norm, Orthogonality, Gram – Schmidt orthonormalization, Orthonormal basis, Expansion in terms of orthonormal basis – Fourier series, Orthogonal complement ,Decomposition of a vector with respect to a subspace and its orthogonal complement – Pythagorus Theorem	07
Unit IV	Eigenvalues and Eigenvectors: What are the ingredients required for diagonalization, Eigenvalue – Eigenvector pairs, Where do we look for eigenvalues,characteristic equation, Algebraic multiplicity, Eigenvectors, Eigenspaces and geometric multiplicity Diagonalizable Matrices: Diagonalization criterion, The diagonalizing matrix, Cayley-Hamilton theorem, Annihilating polynomials, Minimal Polynomial, Diagonalizability and Minimal polynomial, Projections Decomposition of the matrix	06
Unit V	Hermitian Matrices**:** Real symmetric and Hermitian Matrices, Properties of eigenvalues and eigenvectors, Unitary/Orthoginal Diagonalizbility of Complex Hermitian/Real Symmetric matrices, Spectral Theorem, Positive and Negative Definite and Semi definite matrices General Matrices:The matrices AAT and ATA, Rank, Nullity, Range and Null Space of AAT and ATA, Strategy for choosing the basis for the four fundamental subspaces, Singular Values, Singular Value Decomposition, Pseudoinverse and Optimal solution of a linear system of equations, The Geometry of Pseudoinverse	07

Unit VI	Jordan Canonical form: Primary Decomposition Theorem, Nilpotent matrices, Canonical form for a nilpotent matrix, Jordan Canonical Form, Functions of a matrix	06

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome:

1 Students will understand applications of Linear systems.
2 Students will understand Eigenvalues and Eigenvectors.
3 Students will understand Hermitian, Jordan Canonical form of Matrices.

Text Books

1 Linear algebra and its application; D.C.Lay , 3/e ; Addison Wesley; 2004

References

1 Linear Algebra with applications ; Nicholson, McGraw Hill; 2004

Useful Links

http://www.nptel.iitm.ac.in/

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√		√			√			√		√
CO2		√			√			√			
CO3			√				√			√	
CO4				√	√			√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS102: Modern Power System Analysis And Computer Methods

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	**CT1**	15
Tutorial	1 Hr./week	**CT2**	15
Total Credits	**3+1=4**	**TA**	10
		ESE	60

Course Objectives

1 To impart knowledge of techniques of power system analysis
2 To impart knowledge of use of computer in load flow analysis.
3 To ABET standards use of computer is mandatory.

Course Contents		**Hours**
Unit I	Introduction**:** Graph of a power system, incidence matrices, primitive network, formation of network matrices by singular and non singular transformation	6
Unit II	Admittance Model: Node and Branch Admittances, Mutually coupled branches in Y_{bus} , Modification of Y_{bus}, Network incidence matrix and Y_{bus}, Kronb reduction method..	6
Unit III	Impedance Model: Bus admittance and Impedance matrix, Thevenin's Theorem, Modification of Z_{bus}, Direct determination of Z_{bus}, Z_{bus} from Y_{bus}, Mutually coupled branches in Z_{bus}.	6
Unit IV	Load Flow Analysis: Power flow problems, Newton Raphson method, Gauss Seidal method, Power flow solution by N-R method.	6
Unit V	Simultaneous faults: Simultaneous fault by two port network theory, Simultaneous fault connection of Sequence Networks, z type, Y type and H type faults, Two component method, series fault, shunt fault.	6
Unit VI	Economic Load Scheduling**:** Load distribution, Transmission loss equation, Classical economic dispatch, Unit commitment.	6
Tutorial		
	A set of Tutorial/ problems based on above syllabus is to be submitted.	

Course Outcome(CO):

1 Students will understand Graph theory.
2 Students will understand Zbus and Ybus matrix.
3 Student shall understand simultaneous fault calculations

Text Books

1 Computer Methods in Power System Analysis , G.W. Stagg & A.H.El-Abiad McGraw Hill 2003
2 Computer Aided Analysis of Sower System , Kusis, PHI-2006

References

1 Modern Power System Analysis (3rd Edn.) , Kothari & Nagrath TMH.-2004
2 Power System Analysis , Hadi Saadat TMH-2004
3 Advanced Power System Analysis and Dynamics, L. P. Singh WEL-2002

Useful Links

1 http://www.nptel.iitm.ac.in/

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√			√			√			√	
CO2			√			√		√			√
CO3		√			√				√		
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering, Karad
First Year M. Tech. Electrical-Power Systems
PS103:EHVAC

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	**CT1**	15
Tutorial	1 Hr./week	**CT2**	15
Total Credits	**3+1=4**	**TA**	10
		ESE	60

Course Objectives

1 To make students aware of Line parameters.
2 To make students aware of Travelling and Standing waves.
3 To make students aware of over voltages.

Course Contents		**Hours**
Unit I	Introduction: Engineering Aspects and EHVAC transmission line trends and preliminaries, power transfer ability, transient stability limit and surge impedance loading.Calculation of line and ground parameters. Corona effects.	6
Unit II	Theory of Travelling waves and standing waves**:**Waves at power frequency, differential equations and solutions for general case, open ended line, response to sinusoidal excitation	5
Unit III	Lightning and lightening protection: Lightning strokes to lines, their mechanism, General principles of lightning protection problem, tower footing resistance, lightning arresters and protective characteristics, different arrestors and their characteristics.	5
Unit IV	Over voltages due to switching: Types, recovery voltage and circuit breaker, ferro resonance over voltages and calculation of switching surges single phase equivalent	6
Unit V	Power frequency voltage control and over voltages: Generalized constants,charging current, power circle diagram and its use, voltage control, shunt and series compensation, sub synchronous resonance in series capacitor compensated lines and static reactive compensating systems.	6
Unit VI	Insulation coordination: Insulation levels, voltage withstand levels, voltage withstand levels of protected equipments and insulation coordination based on lightning.	5

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Students will understand Line parameters
2 Students will understand Travelling and Standing waves.
3 Students will understand EHVAC over voltages.

Text Books

1 EHVAC Transmission Engineering, R.D. Begamudre, Wiley Estern Ltd. 1999
2 EHVAC and HVDC Transmission system Engineering, TwianGonen, John Wiley and sons, Publications -2002

References

1 EHVAC and HVDC Transmission system Engineering, S. Rao, TMH, 2000

2 Electric power transmission system Engineering, TwianGonen, John Wiley and sons, Publications -2002

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√		√
CO2	√	√	√	√		√	√	√	√	√	
CO3	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√	√	√		√			

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	2	10
Understand	3	2	2	10
Apply	2	3	1	10
Analyze	3	3	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS104: Power System Transients

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	**CT1**	15
Tutorial	1 Hr./week	**CT2**	15
Total credits	**3+1=4**	**TA**	10
		ESE	60

Course Objectives

1 To become familiar with switching transient.
2 To understand protective system for transients.
3 To understand surges in transformers, motors and generators

Course Contents		**Hours**
Unit I	Introduction : Basic concept and simple switching transient, Transients in electric power systems switching of RL, LC, RLC circuits, Transient analysis for 3 phase Power System-Sequence network, Sequence component for unbalanced network impedance, Analysis of unsymmetrical 3 phase faults	6
Unit II	Traveling waves : Internal and external causes of over voltages, Lightning strokes, Mathematical model to represent lightning, Lightening stroke to tower and midspan, Traveling waves in transmission lines, Circuits with distributed constants, Wave equations, Reflection and refraction of traveling waves, Traveling waves at different line terminations, Effect of short length of cables, Shape and attenuation and distortion of traveling waves, Selection of typical wave to represent over voltages, Lattice diagram	5
Unit III	Switching Transients: Switching transients, The circuit closing transient, The recovery transient initiated by the removal of the short circuit, Double frequency transients, Abnormal switching transients, Current suppression, Capacitance switching, Arcing, Transformer inrush current, Ferro resonance, Neutral connections, Transients in switching a three phase reactor, Three phase capacitor, The short line fault	5
Unit IV	Surges In Transformers, Motors And Generators: Step voltage, Voltage distribution in transformer winding, Winding oscillations, Traveling wave solutions, Transformer core under surge conditions,Voltage surges, Transformers, Generators and motors, Transient parameter values for transformers	5
Unit V	Switching Arc , Protective devices and system :The switching arc and its modeling, arc circuit interruption, origin of transient recovery voltage, transient recovery voltage for different types of faults,Basic ideas about protection, Surge diverters, Surge absorbers, Ground fault neutralizers, Protection of lines and stations by shielding, Ground wires, Counter poises, Driven rods, Modern lighting arrestors,Insulation coordination	5
Unit VI	Generation and Measurement of High Voltages And Current : Generation of high AC and DC voltage, Impulse voltage, Impulse current, Measurement using Sphere gaps peak Voltmeters , Potential dividers ,measurement set-up for transient voltage and current .	4

Government College of Engineering Karad

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Students will understand switching transient.
2 Students will understand protective system for transients.
3 Students will understand surges in transformer, motor and generator.

Text Books

1 A statistical approach to power system transients, Dr.C.S.Indulkar ,PHI-2006
2 Transients in Power Systems –Lou Van der Sluis, John Wiley & sons -2003

References

1 Transient Phenomenon in Electrical Power System-V.A.Venikov,McMillan Publications-2005
2 Power System Grounding and transients:An Introduction ,A.P.Sakis Meliopoulos,Marcel Dekker-2005

Useful Links

1 www.ocw.mit.edu
2 http://www.nptel.iitm.ac.in/

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√	√	√	√		√	√	√	√		√
CO2	√	√	√	√	√	√		√	√	√	
CO3	√	√	√	√	√		√	√		√	

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

First Year M. Tech(Electrical) Semester - I
PS107: Digital Protection

Teaching Scheme		Examination Scheme	
Lectures	3 Hrs/week	**CT1**	15
Tutorial	-	**CT2**	15
Total Credits	3	**TA**	10
		ESE	60

Course Objectives:

Student will learn applications of comparator for protection system.
Student will learn use of most suitable relay to protection system.
Student will learn design of digital protection scheme for transformer.
Student will learn analyze the requirements and design a digital protection based system for particular device.

Course Contents

Hours

Relaying Schemes: **6**

Protection schemes for alternator, transformer, bus bar and induction motors. Transmission line protection using over current- time graded and current graded schemes, drawbacks of these schemes, distance schemes, Electromagnetic CT and PT.

Comparators: **6**

a. Dual Input Comparator: Amplitude comparator, phase comparator, duality between amplitude and phase comparators, cosine-type and sine-type phase comparators, coincidence type phase comparator.
b. Multi Input Comparator: Amplitude comparator, phase comparator.

Over Current Relays: **6**

Different time-current characteristics of over current relay, Microprocessor based over current relay, Directional over current relay and its implementation using microprocessor based scheme.

Differential Relays: **6**

Circulating current differential protection, percentage differential protection of power transformers, effect of magnetizing inrush, effect of over voltage inrush, hardware and software used for digital protection of transformer.

Distance Protection: **6**

Microprocessor based impedance, reactance and admittance relays, measurement of R and X. Quadrilateral characteristics. New Digital protection scheme based on upon fundamental signal, hardware and software design. Effect of FACTS devices on distance protection relay.

Recent Developments: **6**

New digital relaying algorithms based on various transform techniques - Discrete

Fourier Transform, Haar Transform etc.

Course Outcome(CO):
Student will be able to apply particular comparator for protection system.
Student will be able to use most suitable protection systems
Student will be able to analyze the requirements and design a digital protection based system for particular device.

Text Books:
Badri Ram, Power System Protection and Switchgear, TMH, 2004.
L.P. Singh, Digital Protection, New Age, Second Edition, 2004.

References:
Y.G. Paithankar, S.R. Bhide, Fundamentals of Power System Protection, PHI, 2003.
T. Johns and S. K. Salman, Digital Protection for Power Systems, IEEE power series15
J. Lewis Backburn, Thomas J. Domin, Protective Relaying Principle and Application, CRC Press, Third Edition

Useful Links:
http://www.nptel.iitm.ac.in/
www.ocw.mit.edu

Mapping of CO and PO

	PO										
	a	b	c	d	e	f	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√	√	√
CO2		√	√	√		√	√	√	√		√
CO3	√	√		√	√	√		√		√	

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS106: Lab Practice - I

Teaching Scheme		**Examination Scheme**	
Lectures	-	**TA/CA**	50
Practicals	4 Hr./week	**ESA**	50
Total Credits	**2**	**Total**	100

Course Contents

Introduction to MATLAB: variables and arrays, sub arrays, special values, scalar and array operations, graphics, rational and logical operators, branching if and switch cases, loops , while loop, for loop , script files, function functions, sub function and private functions.

Linear algebra with MATLAB: solution of linear differential equations, difference equations, eigenvalues and eigenvectors, Fourier analysis, Laplace and z transforms with symbolic math toolbox, partial fraction expansion

Introduction to Simulink : Symbolic math, control and signal processing toolboxes
It should consist of various Practical/Simulation assignments related to all Core subjects and Electives

Representative List of Experiments:

1. To obtain swing equation for a synchronous machine connected to infinite bus.

2. To obtain power angle curve for one machine system before fault, during fault and after
Clearance of fault using Equal Area Criteria.
3. Study of Unit Commitment and Load Scheduling.
4. Transient Stability Analysis using
1) Euler's Method 2) Euler's Modified Method
5. Transient stability analysis using RK2 and RK4 Method.
7. To generate scaling function and wavelet from the 'h' filter.

8.Illustration of simple interpolation and decimation operations.

Course Outcomes(CO):

1 Students will understand various MATLAB functions.
2 Students will understand use of MATLAB to solve linear algebra problems.
3 Students will understand applications of Simulink.

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	√
CO3	√	√	√	√		√		√		√	

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 201: Power System Dynamics And Stability

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand concept of power system dynamics.
2 To become families with stability of power system.
3 To make student familiar with latest control strategies

Course Contents		**Hours**
Unit I	Concept of Power System Dynamics And Stability: Types of stability, stability of synchronous machine, factors affecting stability and recent trends in improving stability, tie line oscillations.	6
Unit II	Large disturbance Stability: System of one machine connected against infinite bus, classical model, and equal area criteria technique and its applications, precalculated swing curve, Evaluation and simulation	5
Unit III	Small disturbance Stability: Two-machine system with and without losses, techniques for S.S.S. limit, effect of inertia, saliency, saturation, governor action and SCR on SS power limit.	7
Unit IV	Excitation System: Effect of excitation system on generator power limit, transformation model of excitation system, dynamic stability, Routh's criteria for dynamic stability, self excited electro-mechanical oscillations in Power System, power system stabilizer	7
Unit V	Multimachine Stability: Machine representation by classical model, voltage stability, angular stability, method of analysis of stability of power system.	6
Unit VI	Prime mover controllers: Control of Voltage, frequency, SCADA for stability, tie line power flow, emergency control techniques for stability. Application of energy functions for direct stability evaluation	5

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcomes

1 Student will understand concept of power system dynamics
2 Student will understand stability of power system
3 Student will understand latest control strategies in power systems.

Text Books

1 Power System stability and Control, P.Kunder , McGraw Hill, New York 2006
2 Power System Stability , E.W.Kimbark, Vol 1 and ,3, Dover Publications- 2004

References:

1 Power System Dynamics, Stability and Control , K.R.Padiyar Interline Publishers, -2003
2 Power System Control and Stability , P.M Anderson and A.A. Fouad - McGraw Hill-2004

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√		√				√			
CO2			√		√		√		√		√
CO3	√				√					√	
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	2	2	10
Apply	2	3	2	10
Analyze	2	2	2	10
Evaluate	2	3	2	10
Create	3	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 202: Real Time Control Of Power Systems

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand concept of load frequency control.
2 To understand necessity and implementation of reactive and optimal power control.

Course Contents		**Hours**
Unit II	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	7
Unit III	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.	7
Unit IV	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 V	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 VI	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.	6

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcomes(CO):

1 Students will understand concept of load frequency control.

2 Students will understand necessity and implementation of reactive and optimal power control.
3 Students will understand concept of concept SCADA and DAS.

Text Books

1 Real Time Control Of Electric Power System—B.Handschlw

2 Recent Trends In Electric Energy System—J.Nanda And D.P. Kothari

References

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 http://www.nptel.iitm.ac.in/

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√			√			√			√	
CO2			√			√		√			√
CO3		√			√				√		
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	1	10
Understand	3	3	2	10
Apply	2	2	1	10
Analyze	3	3	2	10
Evaluate	2	3	2	10
Create	2	2	2	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 203 : Power Electronics Applications In Power System

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand FACTS concept.
2 To become familiar with series and shunt compensation using FACTS devices.

Course Contents		**Hours**
Unit I	FACTS Concept and General System Considerations:- Transmission Interconnections, Flow of Power in an AC System, Loading Capability, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, Relative Importance of Controllable Parameters.	6
Unit II	Basic Types of FACTS Controllers: Brief Description and Definitions of FACTS Controllers, Benefits from FACTS technology, HVDC vs. FACTS Static Shunt Compensators	6
Unit III	SVC and STATCOM: Objectives of Shunt Compensation, Methods of Controllable Var Generation, Static Var Compensators: SVC and STATCOM, Comparison Between STATCOM and SVC, Static Var Systems.	7
Unit IV	Static Series Compensators (GCSC, TSSC, TCSC and SSSC): Objectives of Series Compensation, Variable Impedance Type Series Compensators, Switching Converter Type Series Compensators, External (System) Control for Series Reactive Compensators, Summary of Characteristics and Features.	7
Unit V	Static Voltage and Phase Angle Regulators: (TCVR and TCPAR): Objectives of Voltage and Phase Angle Regulators, Approaches to Thyristor-Controlled Voltage and Phase Angle Regulators (TCVRs and TCPARs), Switching Converter-Based Voltage and Phase Angle Regulators, Hybrid Phase Angle Regulators.	6
Unit VI	Combined Compensators:- Unified Power Flow Controller (UPFC) and Interline Power Flow Controller (IPFC), Introduction, The Unified Power Flow Controller, The Interline Power Flow Controller (IPFC), Generalized and ultifunctional FACTS Controllers.	6

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcomes(CO):

1 Student will understand concept of FACTS .
2 Student will understand series and shunt compensation
3 Student will understand voltage regulation of transmission line.

Text Books

1 Understanding FACTS , N.G. Hingorani IEEE Press, 1999

2 Flexible AC transmission systems (FACTS) , Yong Hua Song IEE Press, 1999

References

1 Power Electronic Control in Electrical Systems , E. Acha, V.G. Agelidis, O. Anaya-Lara, T. J.E. Miller Newnes Power Engineering Series, Oxford, 2002

Useful Links

1 http://www.nptel.iitm.ac.in/

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√		√				√			
CO2			√		√		√		√		√
CO3	√				√					√	
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	2	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	3	2	10
Create	2	2	1	10
Total	15	15	10	60

ELECTIVE -I

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 214: Elective I – Power Quality

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand importance of power quality issue.
2 To understand causes effects and remedies of Harmonics.

Course Contents		**Hours**
Unit I	Power Quality: Introduction, Electromagnetic phenomena – Transients, Long and short duration voltage variations, wave form distortion	5
Unit II	Voltage Sag and Interruptions: End user issues: Ferroresonant Transformers, UPS systems Voltage Tolerance envelops of CBEMA & ITIC, Reliability Indices	6
Unit III	Monitoring Power Quality: PQ measurement equipment and their use, wiring and grounding : Typical wiring and grounding problems, solutions with proper grounding practices and use of signal reference grid	7
Unit IV	Fundamentals of Harmonics: Representation characteristic harmonics, Harmonic indices Harmonic sources-6&12 pulse related harmonics, harmonic effects on power apparatus and on measurements, interference with communications	6
Unit V	Harmonic Elimination: Shunt passive filters, types, Design considerations and illustrative examples, Active filters : types, current and voltage source active filters, shunt, series & Hybrid active filters	7
Unit VI	Harmonic Measurements: Analysis and Digital methods, presentation of Harmonic data, Response and standards for their limitation	6

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcomes(CO):

1 Students will understand importance of power quality
2 Students will understand causes effects and remedies of Harmonics
3 Students will understand importance of Harmonic Elimination.

Text Books

1 Electrical Power Systems Quality, Roger C. Dugan, Mark F. Mc Granton & H. Wayne Beety, McGraw Hill

2 Power System harmonics , J. Arillaga, DA Bradley & PS Bodger,,John Wiley Sons

References

1 Electric Power Distribution Reliability, Richard E. Brown," CRC Press.
2 Power System Harmonics - Fundamentals, Analysis & filter Design, George J. Wakileh,

Springer

3 Power System Harmonics - Fundamentals, Analysis & filter Design, George J. Wakileh, Springer

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√			√		√	√			√
CO2	√			√					√		
CO3		√			√	√		√		√	
CO4			√								√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	1	9
Understand	3	3	2	12
Apply	2	3	2	10
Analyze	2	2	2	8
Evaluate	3	2	2	10
Create	2	3	1	11
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 224: Elective I – Neural Network And Fuzzy Logic

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course objective :

1 To understand basics of Neural Networks and Fuzzy Logics.
2 To use Neuro Fuzzy techniques in power system applications.

Course Contents :		**Hours**
Unit I	Introduction : Basic Concepts of Neural Network, brain as a NN, properties of neuron, supervised and unsupervised models, layers in a network, single layer and multilayer feed forward network, recurrent networks, learning and training, learning rules (unsupervised and supervised learning laws).	6
Unit II	Hopfield Model: basic model, cellular neural networks, perception, introduction to adaptive resonance theory, network for ART-1 and ART-2, Kohoran map, training law.	5
Unit III	Training: Training of multilayer feed-forward network by backpropagation, training aspects and variations of back propagation method, back propagation as stochastic approximation, counter propagation network, radial basis function networks.	6
Unit IV	Fuzzy Set Theory : fuzzy versus crisps, crisps sets, fuzzy sets – membership function, basic fuzzy set operations, properties of fuzzy sets, crisps relations, fuzzy relations	6
Unit V	Fuzzy Systems : crisps logic, laws and inference in propositional logic, predicate logic, interpretation of predicate logic formula, inference in predicate logic, fuzzy logic, fuzzy quantifiers, fuzzy inference, fuzzy rule based system, defuzzification method	6
Unit VI	Fuzzy Control Systems: Introduction, simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems , inverter pendulum ,Image processing . home heating system ,Adaptive fuzzy systems, hybrid systems.	7

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcomes(CO):

1 Students will understand basics of Neural Networks and Fuzzy Logics
2 Students will understand Neuro Fuzzy techniques.
3 Students will understand Fuzzy Control Systems.

Text Books

1 Neural Networks – Algorithms and Applications, M. Anand Rao & J. Srinivas Narosa Publishing House, New Delhi.-2006
2 Neural Networks, Fuzzy Logic and Genetic Algorithms – Synthesis and Applications , S. Rajasekaran & G.A.

Vijayalakshmi Pai Prentice-Hall of India Private Limited.-2005

References

1 Fundamentals of Neural Networks, Architectures, Algorithms and Applications, Laurene Fausett Prentice Hall, Englewood Cliffs-2005.

2 Artificial Neural Networks – Theory and Applications , Patterson Dan W Prentice Hall.-2006

3 A course in Fuzzy Systems and Control , Li-Xin Wang Prentice Hall-2004

4 Foundations of Neural Networks, Fuzzy Systems and Knowledge Engineering , Nikola K. Kasabov, MIT press -2006

Useful Links

1 http://www.nptel.iitm.ac.in/

2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√	√		√	√		√		√	√
CO2		√		√			√		√		
CO3	√					√		√			√
CO4					√						

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	1	10
Understand	2	3	2	10
Apply	2	3	2	10
Analyze	3	2	2	10
Evaluate	2	3	2	10
Create	3	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 234: Elective I - Embedded Systems

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand Process and memory organization in Embeded system.
2 Use of embedded system in power systems.
3 To understand Real Time Operating Systems.

Course Contents		**Hours**
Unit I	Introduction to embedded systems, Background and History of Embedded Systems, definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, low-level versus high level languages, main language implementation issues: control, typing, exception handling, modularity and multi-threading. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.	7
Unit II	Processor and Memory Organization I: Structural units in processor, Processor selection for an embedded system, Memory devices, Memory selection, Allocation for memory to program segments and blocks and memory map of a system, DMA, Interfacing processor. I/O Devices - Device I/O Types and Examples	6
Unit III	Processor and Memory Organization II: Synchronous - Iso-synchronous and Asynchronous Communications from Serial Devices - Examples of Internal Serial-Communication Devices - UART and HDLC – Parallel Port Devices - Sophisticated interfacing features in Devices/Ports- Timer and Counting Device	6
Unit IV	Device Drivers and Interrupts Servicing Mechanism: Device driver , parallel port device driver in a system, serial port device driver in a system, device driver for internal programmable timing devices. Interrupt servicing (handling) Mechanism, Context and the period for context switching. Deadline and interrupt latency.	5
Unit V	Real Time Operating Systems: RTOS Task scheduling models - Handling of task scheduling and latency and deadlines as performance metrics – Co-operative Round Robin Scheduling – Cyclic Scheduling with Time Slicing (Rate Monotonics Co-operative Scheduling) – Preemptive Scheduling Model strategy by a Scheduler – Critical Section Service by a Preemptive Scheduler – Fixed (Static)	7
Unit VI	Software Engineering Practice in the Embedded Systems: Software analysis design, implementation, testing, validation and debugging of embedded systems	5

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Students will understand Process and memory organization in Embeded system.
2 Students will understand use of embedded system in power systems.

3 Students will understand Fuzzy Control Systems.

Text Books

1 Embedded Software primer by David Simon Pearson Education-2005
2 Embedded Systems Architecture, Design and programming , Raj Kamal Tata McGraw-Hill, 2003

References

1 Programming Embedded Systems in C and C++, Michael Barr O'Reilly, USA Aug. 1999

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√		√		√			√		
CO2	√		√		√		√			√	√
CO3					√			√			√
CO4			√					√			

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	1	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	2	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 244: Elective I - Digital Image Processing

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand concept of Image Processing.
2 To apply Image processing in Power Systems.
3 To understand Region growing techniques.

Course Contents		**Hours**
Unit I	Digital Image Representation: digitizing images, discrete curves, connected component, space frequency representation, multi resolution representation.	6
Unit II	Basics Tools In Image Processing: point operations (LUT), neighborhood processing (linear filtering, rank filtering, basic morphological filtering).	5
Unit III	Image Enhancement Techniques And Image Restoration : ad'hoc and optimal techniques;	5
Unit IV	Extraction and characterization of visual cues in images : edge detection techniques (first and second derivative operations, matched filtering, optimal edge detectors),	6
Unit V	Texture characterization (co – occurrence matrices, RLC, curvilinear integration, ARMA modeling), Image segmentation; fixed and adaptive histrogram thresholding, boundary detection and extraction (edge thinning, edge following & edge closing),	7
Unit VI	Region growing techniques, Split & Merge techniques, statistical image segmentation by markovian techniques; Statistical Pattern recognition techniques in images : methods, applications. Image analysis and scene description.	7

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Students will understand concept of Image Processing.
2 Student will apply Image processing in Power Systems.
3 Students will understand Region growing techniques.

Text Books

1 Fundamental of Digital Image Processing by Anil K.Jain Prentice Hall-2004

References

1 Digital Image Processing 2nd Edition by Gonzalez & Woods Prentice Hall -2005

2 Digital Image Processing using MATLAB Gonzalez & Woods Prentice Hall - 2004

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√		√			√			√		√
CO2		√			√			√			
CO3			√				√			√	
CO4				√	√			√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	2	1	10
Understand	3	3	2	10
Apply	2	3	2	10
Analyze	2	3	2	10
Evaluate	2	2	2	10
Create	3	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 215: Elective II – Optimal Control

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1. To understand calculus of variation and dynamic programming.
2. To apply calculus of variation and dynamic programming for solving optimal control problems.
3. To apply optimal control techniques in power system.

Course Contents		**Hours**
Unit I	Introduction: Static and dynamic optimization. Parameter optimization.	5
Unit II	Caculus of Variations: problems of Lagrange,. Mayer and Bolza. Euler-Language equation and transversality conditions, Lagrange multipiliers.	7
Unit III	Pontryagin's Maximum Principle: theory; application to minimum time, energy and control effort problems, and terminal control problem.	6
Unit IV	Dynamic Programming: Belaman's principle of optimality, multistage decision processes. application to optimal control.	5
Unit V	Linear Regulator Problem: matrix Riccati equation and its solution, tracking problem.	6
Unit VI	Computational Methods in Optimal Control: application of mathematical programming. Singular perturbations, practical examples.	7

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1. Student will understand calculus of variation and dynamic programming
2. Student will understand calculus of variation and dynamic programming for solving optimal control problems.
3. Student will understand optimal control techniques in power system.

Text Books

1. Optimal Control Theory, D.E.Kirk Prentice-Hall. 1970
2. Optimum Systems Control, 2nd ED., A.P.Sage and C.C.White II Prentice-Hall, 1977

References

1. Optimal Control by Mathematical Programming, , D.Tabak and B.C.Kuo Prentice-Hall, 1971.
2. Linear Optimal Control, B.D.O. Anderson and J.B.Moore Prentice-Hall, 1971.

Useful Links

1. http://www.nptel.iitm.ac.in/
2. www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√			√			√			√	
CO2			√			√		√			√
CO3		√			√				√		
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 225: Elective II – High Voltage Engineering

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand behavior of high voltage for breakdown.
2 To understand effect of high voltage on power system components.
3 To understand High Voltage Testing and EHV Lines Design

Course Contents		**Hours**
Unit I	Mechanism Of Breakdown In Gases: Classification of insulating materials. Gases as insulating media, Ionization & decay process, breakdown in gases. Townsend's law. The streamer mechanism of spark Paschen's law, corona discharge, electronegative gases.	6
Unit II	Breakdown In Liquid And Solid Dielectrics : Breakdown in pure and commercial liquids, Solid Dielectrics and composite dielectrics, High Voltage bushings, Guarding, Shielding, Field Plotting.	5
Unit III	Lightning And Switching Over Voltages And Protection: Lightning strokes to lines and towers , mechanism & characteristics. Protection of transmission lines from lightning, Lightning Arrestors. Insulation co-ordination of HV and EHV transmission line, Power system and substation.	7
Unit IV	High Voltage And Current Generation: Generation of High D.C , A.C. and Impulse voltages , Standard impulse wave shapes , Switching Surges , High Impulse Generator	6
Unit V	High Voltage And Current Measurement: Peak voltage , Impulse voltage and High Direct current Measurement methods , Non-destructive measurement and testing , High Voltage dielectrics Loss and capacitance measurement , Radio Frequency and partial discharge measurement.	7
Unit VI	High Voltage Testing and EHV Lines Design: Basic Terminology , Testing – Insulation , Bushings , Cables , Transformers, Surge Divertors and Isolators , Electric Shock and threshold current , capacitance of long objects , electromagnetic Interference , EHV line insulation design based upon transient over voltages.	7

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Student will understand behavior of high voltage for breakdown.
2 Student will understand effect of high voltage on power system components.
3 Student will familiar with High Voltage Testing and EHV Lines Design

Text Books

1 High Voltage Engineering , M.S. Naidu and V. Kamaraju Tata McGraw Hill Pub. Co. 2006
2 High Voltage Engineering , E. Kuffel and W.S. Zaenglo Pergamon Press -2005

3 EHV AC Transmission Engineering , Rokosh Das Begamudre Wiley Eastern Ltd. New Delhi.2005

References

1 SF6 and Vacuum Insulation for High Voltages Applications, M.S.Naidu and V.N.Maller Khanna Pub. New Delhi-2005.
2 High Voltage Engineering , D.V.Razevig Khanna Pub. New Delhi -2004

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√		√				√			
CO2			√		√		√		√		√
CO3	√				√					√	
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 235: Elective II – Energy Management And Energy Audit

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To become familiar with concept of Energy Audit.
2 To understand energy monitoring and energy Audit.
3 To understand Energy Conservation and Recycling

Course Contents		**Hours**
Unit I	Energy Scenario: Primary energy resources, Commercial and Non-commercial energy, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment	6
Unit II	Energy management : Definition, significance and objectives of energy management, principle of energy management , sectors of supply side management , Energy and economy, electricity tariff, load management and maximum demand control, power factor improvement, selection and location of capacitors ,optimizing the input energy requirements, fuel and energy substitution	7
Unit III	Energy strategies and energy planning: Energy Action Planning: Key elements, force field analysis, Energy policy purpose, Energy planning flow for supply side, essential data for supply side energy planning, roles and responsibilities of energy manager,	5
Unit IV	Energy Audit: Definition, need of energy audit, types of energy audit, intermediate and comprehensive energy audit, end use of energy consumption profile, procedure of energy auditing, site testing and measurement. Energy security, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, energy audit instruments, Energy Conservation Act-2001	7
Unit V	Energy Conservation and Recycling: Energy conservation and its importance, Listing of energy conservation opportunities (ECOs), Electrical ECOs, ECOs in process industry, small industries building and shopping complexes , waste management , Recycling of discarded materials and energy recycling	6
Unit VI	Energy Monitoring and Targeting: Defining monitoring and targeting, elements of monitoring and targeting, data and information-analysis, On line energy monitoring: Various aspects and techniques of on line energy monitoring, Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams. Financial analysis techniques-simple pay back period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis, financing options, energy performance contracts .	8

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Student will become familiar with concept of Energy Audit.
2 Student will understand energy monitoring and energy Audit.
3 Student will understand Energy Conservation and Recycling.

Text Books

1 Energy –Economy and prospective –Andre Gardel , Pergmann Press-2005
2 Introduction to energy technologies – V.A.Venikov ,E.V.Putiatin , Mir, Moskow -2006
3 Electrical Energy utilization and energy conversion –S.C.Tripathy, Tata Mc-GrawHill -2003
4 Conventional energy technology – S.B.Pandya, Tata Mc-GrawHill -2003

References

1 Energy and Atmosphere- I.M.Campbell, Wiley, New York -2000
2 Power station engineering and economy-Skortzki and Vopat , Tata Mc-GrawHill -2003

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√			√		√	√			√
CO2	√			√					√		
CO3		√			√	√		√		√	
CO4			√								√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	2	3	1	10
Understand	3	2	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	3	2	10
Create	3	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 245: Elective II – Power System Deregulation

Teaching Scheme		**Examination Scheme**	
Lectures	3 Hrs/week	CT1	15
Tutorial	1 Hr./week	CT2	15
Total Credits	3+1=4	TA	10
		ESE	60

Course Objectives

1 To understand concept of power system deregulation.
2 To become familiar with restricting of power system.

Course Contents		**Hours**
Unit I	Fundamentals of Restructured System**:** History of power system restructuring, concept of power system deregulation, regulation vs. deregulation, entities in deregulated system, market architecture, ancillary services	6
Unit II	Models of Restructuring: PoolCo and bilateral contractual models, ISO based markets models, reactive power balancing market, day ahead and hour ahead markets.	6
Unit III	Transmission Pricing: Cost components in transmission pricing, embedded cost based transmission pricing methods, Postage Stamp, MW-Mile, incremental cost based or location marginal pricing (LMP), Tracing of power.	6
Unit IV	Transmission Open Access Issues**:** Available Transfer Capability (ATC)- definition and methods of determination, transmission network congestion, congestion management techniques.	6
Unit V	Power Sector Restructuring in India: Electricity Act 2003, Evaluation of integrated, monopoly, state owned electricity boards, introduction to various institutions in Indian power sector & their role.	6
Unit VI	Challenges before the Indian power sector: Planning commission CEA,NT,PFC, ministry of power, SEBS.	6

Tutorial

A set of Tutorial/ problems based on above syllabus is to be submitted.

Course Outcome(CO):

1 Student will become familiar with concept of power system deregulation.
2 Student will understand Transmission Pricing.
3 Student will become familiar with Power Sector Restructuring in India.

Text Books

1 Electric Utility Planning and regulation – Edward Kahn , University of California- 2005

References

1 Various Indian Electricity Acts 1). Indian Electricity Act , 1910 2)The Electricity Supply Act , 1998 proposed Electricity Bill 2001
2 Electrical Energy Utilization And Conservation :- S.C. Tripathi(TMH Pub.)-2003

Useful Links

1 http://www.nptel.iitm.ac.in/
2 www.ocw.mit.edu

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1		√		√				√			
CO2			√		√		√		√		√
CO3	√				√					√	
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	3	2	10
Apply	2	3	2	10
Analyze	2	2	2	10
Evaluate	3	2	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 206: Lab Practice - II

Teaching Scheme		**Examination Scheme**	
Lectures	-	**TA/CA**	50
Practical's	4 Hr./week	**ESA**	50
Total Credits	**2**	**Total**	100

Representative List of Experiments:

1 Program introduces the symbolic math tool box

2 Program illustrates the factoring expressions and solving equation
3 Program explains DEFINING , EVALUATING and PLOTTING FUNCTION
4 Program of illustration of DIFFERENTIAL CALCULUS
5 Program illustrates DERIVATIVES
6 Program illustrates multivariable calculus

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√			√			√			√	
CO2			√			√		√			√
CO3		√			√				√		
CO4			√			√		√			√

Assessment Pattern

Knowledge Level	CT1	CT2	TA	ESE
Remember	3	3	1	10
Understand	3	2	2	10
Apply	3	3	2	10
Analyze	2	2	2	10
Evaluate	2	3	2	10
Create	2	2	1	10
Total	15	15	10	60

Government College of Engineering Karad
First Year M. Tech. Electrical-Power Systems
PS 207: Seminar-I

Seminar Scheme | **Examination Scheme**

Practical 2 Hrs/week | **CA** 50

Total Credits 1

Course Objectives

1 Post graduate should know the state of the art in the relevant subjects of structural engineering.
2 Post graduate should know the experimental procedure to validate theories related to structural engineering.
3 Post graduate should learn how to prepare and present research project.

Course Contents

1 Seminar-I to be delivered by the students on general topic related to structural engineering to be evaluated by three members committee headed by HOD wherein guide should be one of the members.

List of Submission

1 Seminar report duly signed by respective guide and head of department

Course Outcome(CO):

1 Post graduate will know the state of the art in the relevant subjects of structural engineering.
2 Post graduate will know the experimental procedure to validate theories related to structural engineering.
3 Post graduate will be able to prepare and present research project.

Mapping of CO and PO

	A	b	C	d	e	f	G	h	i	j	K
CO1	√	√	√	√	√	√	√	√		√	√
CO2	√	√	√	√	√		√	√	√	√	√
CO3	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√				√	√	√	

Assessment Pattern

Knowledge Level	CT1	CT2	CA/TA	ESE
Remember			09	
Understand			09	
Apply			08	
Analyze			08	
Evaluate			08	
Create			08	
Total			50	

Government College of Engineering Karad
Second Year M. Tech. Electrical-Power Systems
PS 301: Seminar-II

Laboratory Scheme | **Examination Scheme**
Practical 2 Hrs/week | **CA** 50
Total Credits 1

Course Objectives

1 Post graduate should know the state of the art in the relevant subjects of structural engineering.
2 Post graduate should know the experimental procedure to validate theories related to structural engineering.
3 Post graduate should be able to conduct extensive literature survey in subjects of structural engineering.
4 Post graduate should learn how to prepare and present research project.

Course Contents

1 Seminar-II to be delivered by the students on general topic related to structural engineering to be evaluated by three members committee headed by HOD wherein guide should be one of the members.

List of Submission

1 Seminar report duly signed by respective guide and head of department

Course Outcome(CO):

1 Post graduate should know the state of the art in the relevant subjects of structural engineering.
2 Post graduate should know the experimental procedure to validate theories related to structural engineering.
3 Post graduate should be able to conduct extensive literature survey in subjects of structural engineering.
4 Post graduate should learn how to prepare and present research project.

Mapping of CO and PO

	A	b	C	d	e	F	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	
CO3	√	√	√	√	√	√		√	√	√	√
CO4	√	√	√	√				√		√	√

Assessment Pattern

Knowledge Level	CT1	CT2	CA/TA	ESE
Remember			09	
Understand			09	
Apply			08	
Analyze			08	

Evaluate			08	
Create			08	
Total			50	

Government College of Engineering Karad
Second Year M. Tech. Electrical-Power Systems
PS 302: Dissertation Phase-I

Laboratory Scheme		**Examination Scheme**	
Practical	20 Hrs/week	**TA/CA**	100
Total Credits	10		

Course Objectives

1 To perform extensive literature survey on the research topic of work.
2 To identify the problem statement for the research work.
3 To decide methodology for the research work.
4 To carry out initial mathematical modeling or experimental set up.

Course Contents

1 Dissertation (Phase-I): Student has to submit the report and deliver the seminar based on 25% or more work on Dissertation topic. It is to be evaluated internally by three members panel of examiners headed by HOD wherein guide should be one of the members of the panel. Last date of submission of report shall be two weeks before the end of semester.

List of Submission

1 Dissertation report of phase-I duly signed by respective guide and head of department

Course Outcome(CO):

1 Student will perform extensive literature survey on the research topic of work.
2 Student will be able to identify the problem statement for the research work.
3 Student will decide methodology for the research work.
4 Student will be able to carry out initial mathematical modelling or experimental set up.

Mapping of CO and PO

	a	b	C	d	e	f	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√	√	√
CO2	√	√	√	√	√	√	√	√	√	√	
CO3	√	√	√	√		√	√	√	√	√	√
CO4	√	√	√	√				√			

Assessment Pattern

Knowledge Level	CT1	CT2	CA/TA	ESE
Remember			18	
Understand			17	
Apply			16	
Analyze			17	
Evaluate			16	
Create			16	
Total			100	

Government College of Engineering Karad
Second Year M. Tech. Electrical-Power Systems
PS 401: Dissertation Phase-II

Laboratory Scheme		**Examination Scheme**	
Practical	30 Hrs/week	**TA/CA**	100
Total Credits	20	**ESE**	200

Course Objectives

1 To perform further literature survey on the research topic of work.
2 To carry out detailed mathematical modelling or experimental validation.
3 To draw inferences from the findings and present conclusion.
4 To learn presentation skills for technical report.

Course Contents

1 Dissertation (Phase-II): Internal assessment of dissertation (complete work) is to be carried out by the guide for 100 marks. The external assessment of dissertation work is to be carried out by panel of examiners consisting of internal (guide) and external examiner for 200 marks. Candidate shall present the entire work on Dissertation, followed by viva-voce.
Last date of submission of dissertation will be the end of the semester. Please see Appendix- C of Rules & Regulation For Further information.

List of Submission

1 Dissertation report of phase-II duly signed by respective guide and head of department

Course Outcome(CO):

1 Student will be able to study technical reports on the research topic of work.
2 Student will be able to carry out detailed mathematical modelling or experimental validation.
3 Student will be able to draw inferences from the findings and present conclusion.
4 Student will be able to learn presentation skills for technical report.

Mapping of CO and PO

	a	b	c	d	e	f	g	h	i	j	k
CO1	√	√	√	√	√		√	√	√		√
CO2	√	√	√	√	√	√	√	√	√	√	
CO3	√	√	√	√	√	√	√	√	√	√	√
CO4	√	√	√	√				√			

Assessment Pattern

Knowledge Level	CT1	CT2	CA/TA	ESE
Remember			18	36
Understand			17	34
Apply			16	32
Analyze			17	34
Evaluate			16	32
Create			16	32
Total			100	200