

(An Autonomous Institution)

**M.E- Power Systems Engineering** 

(Dept of EEE)

# **CURRICULUM and SYLLABI**

[For students admitted in 2023-2024]

# **PG Regulations 2023**

Approved by BOS and Academic Council meetings

# Sona College of Technology, Salem (An Autonomous Institution) Courses of Study for M.E /M.Tech. Semester I under Regulations 2023 (CBCS)

S.No	Course Code Course Title		L	T	P	J	С	Category	Total Contact Hours	Course Type*
		Theory cours	es							
1.	P23PSE101	Advanced Power System Analysis	3	0	0	0	3	PC	45	Т
2.	P23PSE102	Electric and Hybrid Vehicles	3	0	2	0	4	PC	75	TL
3.	P23PSE103	High Voltage and Insulation Systems	3	0	0	0	3	PC	45	Т
4.	P23PSE501	Elective: Power Quality	3	0	0	0	3	PE	45	Т
5.	P23MAT501	Elective: Mathematical Methods for Power Engineering	2	1	0	0	3	PE	45	TT
6.	P23GE101	Research Methodology and IPR	3	0	0	0	3	PC	45	Т
7.	P23GE701	Audit Course: English for Research Paper Writing	2	0	0	0	0	AC	30	Т
		Practical cour	ses							
8.	P23PSE104	Advanced Power System Simulation Laboratory	0	0	4	0	2	PC	60	L
		Total Credits					21			

## **Branch: Power Systems Engineering**

\*T- Theory, TT- Theory with Tutorial, TL- Theory with Laboratory, TP- Theory with Project, TLP- Theory with Laboratory and Project, L-Laboratory, LT- Laboratory with Theory, LP- Laboratory with Project

## **Approved By**

S. por	mirakunar	J. Illand	J. diland >
Chairperson, - BoS	Member Secretary, Academic Council	Dean-Academics	Chairperson, Academic Council & Principal
Dr.S.Padma	Dr.R.Shivakumar	Dr.J.Akilandeswari	Dr.S.R.R.Senthil Kumar

Copy to:-

HOD/EEE, First Semester EEE Students and Staff, COE

PG Regulations-2023

NEW-PSE

# Sona College of Technology, Salem (An Autonomous Institution) Courses of Study for M.E /M.Tech. Semester II under Regulations 2023 (CBCS) **Branch: Power Systems Engineering**

S.No	Course Code	-Course Title		T	P	J	C	Category	Total Contact Hours	Course Type*
		Theory cour	rses							
1.	P23PSE201	Modern Power System Protection	3	0	2	0	4	PC	75	TL
2.	P23PSE202	Power System Dynamics and Stability	3	0	0	0	3	PC	45	Т
3.	P23PSE203	Restructured Power Systems	3	0	0	0	3	PC	45	T.
4.	P23PSE506	Elective: Smart Grid	3	0	0	0	3	PE	45	Т
5.	P23PSE511	Elective: Industrial Automation	3	0	0	0	3	PE	45	Т
6.	P23GE702	Audit Course: Stress Management by Yoga	2	0	0	0	0	AC	30	Т
		Practical cou	rses							
7.	P23PSE204	Power Electronics Applied to Power Systems Laboratory	0	0	4	0	2	PC	60	L
8.	P23PSE205	Automation Laboratory	0-	0	4	2	3	PC	90	LP
1997 - 1997 -		Total Credits	2				21	ł		

\*T- Theory, TT- Theory with Tutorial, TL- Theory with Laboratory, TP- Theory with Project, TLP- Theory with Laboratory and Project, L-Laboratory, LT- Laboratory with Theory, LP- Laboratory with Project

#### **Approved By**

S. Padrie	Mirakunar	J. dulano >	
Chairperson, Electrical and Electronics Engineering BoS	Member Secretary, Academic Council	Dean-Academics	Chairperson, Academic Council & Principal
UI.S. PARS Badma	Dr.R.Shivakumar	Dr.J.Akilandeswari	Dr.S.R.R.Senthil Kumar

Professor and Head,

Department of EEE,

Sona College of Technolog Salopy 696 005. Tamil Nad HOD/EEE, Second Semester M.E -PSE Students and Staff, COE

# Sona College of Technology, Salem (An Autonomous Institution) Courses of Study for M.E /M.Tech. Semester I under Regulations 2023 (CBCS)

S.No	Course Code Course Title		L	T	P	J	С	Category	Total Contact Hours	Course Type*
		Theory cours	es							
1.	P23PSE101	Advanced Power System Analysis	3	0	0	0	3	PC	45	Т
2.	P23PSE102	Electric and Hybrid Vehicles	3	0	2	0	4	PC	75	TL
3.	P23PSE103	High Voltage and Insulation Systems	3	0	0	0	3	PC	45	Т
4.	P23PSE501	Elective: Power Quality	3	0	0	0	3	PE	45	Т
5.	P23MAT501	Elective: Mathematical Methods for Power Engineering	2	1	0	0	3	PE	45	TT
6.	P23GE101	Research Methodology and IPR	3	0	0	0	3	PC	45	Т
7.	P23GE701	Audit Course: English for Research Paper Writing	2	0	0	0	0	AC	30	Т
		Practical cour	ses							
8.	P23PSE104	Advanced Power System Simulation Laboratory	0	0	4	0	2	PC	60	L
		Total Credits					21			

## **Branch: Power Systems Engineering**

\*T- Theory, TT- Theory with Tutorial, TL- Theory with Laboratory, TP- Theory with Project, TLP- Theory with Laboratory and Project, L-Laboratory, LT- Laboratory with Theory, LP- Laboratory with Project

## **Approved By**

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Chairperson, - BoS	Member Secretary, Academic Council	Dean-Academics	Chairperson, Academic Council & Principal
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HOD/EEE, First Semester EEE Students and Staff, COE

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NEW-PSE

Sona College of Technology

**Department of Mathematics** 

E.		ELECTR	ICAL AND E	LECTRONICS EN	IGINEERI	NG				
		М.	E. / POWER	SYSTEM ENGINE	EERING					
SEME	STER - I	MATHE	MATICAL M	ETHODS FOR PO	OWER	L	T	P	J	C
P23M	IAT501		ENGINEERING 2 1					0	0	3
Course	Outcomes		4			- No.				
At the e	nd of the cour	rse, the student	will be able to							
CO1: find the rank of the matrix and solve linear system of equations by direct and indirect m								t met	hods.	
CO2:	apply the co diagonaliza	oncepts of eigention.	envalues and ei	genvectors of a real	matrix and	their pro	opert	ies in		
<b>CO3</b> :	find the pov	wer spectral de	ensity for the w	ide sense stationary	process.					
<b>CO4</b> :	apply the su	uitable method	s to solve linea	r programming prol	olem.					
CO5:	apply the apply	ppropriate met	hods to solve n	ionlinear programm	ing problem	1.				
Pre-req	uisites:			Derive	of against					
•	Basics of linea Basics of calcu	r algebra ilus		Basics     Basics	of statistics	and prob	abilit	y		
		(3/2/1 indicate	CO/Post the strength of	<b>O, PSO Mapping</b> correlation) 3-Strong	2-Medium	1-Weak				
CO		Programm	e Outcomes (PC	os) and Programme Sp	ecific Outco	mes (PS	Os)			
	PO1		PO2	PO3	PO	)4		PO5		
CO1	3		3	2	3	3		3		
CO2	3		3	2	3	3		3		
CO3	3		3	2	- 3	- 3		3		
CO4	3		3	2	3	3			3	
CO5	3		3	2	3	3				
			Course assess	sment methods [The	ory]					
		Di	irect			]	ndire	ect		
CIE test CIE test CIE test Assignn Seminar	I (10) (Theory II (10) (Theor III (10) (Theor III (10) (Theo hent / Problem (10)	/) y) ry) - solving /	Total CIE: 4 Semester En marks	0 marks d Examination: 60		Cours	e end	l surv	ey	
Unit 01	LINEAR S	YSTEM OF I	EQUATIONS						9 Ho	urs
Rank o Jordan,	f a matrix – Gauss – Jaco	solution of linbi and Gauss -	near system of - Seidel metho	f equations by matr ds.	rix method,	Gauss	elimi	natio	n, Ga	uss ·
Unit 02	EIGEN VA	LUES AND	EIGEN VECT	ORS					9 Ho	urs
Eigenva diagona	alues and eig	envectors – p mmetric matri	roperties of ei ces.	genvalues and eige	nvectors –	Cayley-	Ham	ilton	theor	rem ·
Unit 03 RANDOM PROCESSES							9 Ho	urs		
Classifi	cation of ran es – Auto con	ndom processo relation functi	es – first orde on and its prop	er, second order, s perties – Power spec	trictly static tral density	onary, v function	and	sense its pr	stati	onar ies.

BoS Date: 08. 07. 2023

M. E / M. Tech Regulations 2023

Sona College of Technology

**Department of Mathematics** 

Unit 04 LINEAR	PROGRAMMING				9 Hours
Simplex algorithm	- Big-M method - trans	sportation problem -	assignment problem	ι.	
Unit 05 NONLIN	EAR PROGRAMMIN	IG of			9 Hours
Formulation of no constrained optimiconstraints.	onlinear programming ization with inequality	problem – constrain ty constraints – K	ed optimization w Luhn-Tucker condit	ith equality tions with	constraints – non-negative
Theory: 30 Hrs	Tutorial: - 15 Hrs	Practical:	Project:	Total Hou	urs: 45 Hrs
TEXT BOOKS:					
1. P. K. Gupta Edition, 201	and D. S. Hira, "Proble 5.	ms in Operation Rese	arch", Sultan Chand	l and Sons P	ublishers, 4 <sup>th</sup>
2. T. Veeraraja Networks",	n, "Probability, Statistic McGraw Hill Publisher	cs and Random Proce s, 4 <sup>th</sup> Edition, 7 <sup>th</sup> Repr	sses with Queueing rint, 2018.	Theory and	Queueing
3. T. Veeraraja	an, "Linear Algebra and	Calculus", McGraw	Hill Publishers, 2019	9.	
<b>REFERENCE BOO</b>	DKS:				
1. H. A. Taha,	"Operation Research: A	In Introduction", Pear	son Publishers, 9 <sup>th</sup> H	Edition, 2014	4.
2. M. K. Venk	ataraman, "Higher Math	ematics for Engineer	ing and Science", N	ational Publ	ishers, 2000.
3. B. S. Grewa	l, "Higher Engineering	Mathematics", Khann	a Publishers, 44 <sup>th</sup> E	dition, 2018	
Dr. S. Associ	JAYABHARATE TE PROFESSOR & HEAD	1	Dr. M.R. Professor	NUGA & Head, nities & Lar	,
DEPART SONA COL SALE Ph	LEGE OF TECHNOLO M-636 005. Tamilnadu. 0427 - 4099999.	GY, De	Sona College o SALEM -	of Technol 6	~~¥
ł	10D / Mathematics	B	05 - Champerson / Sc	arence and Hu	mannues

BoS Date: 08. 07. 2023

M. E / M. Tech Regulations 2023

#### P23PSE101

#### **COURSE OUTCOMES:**

At the end of the course, the students will be able to,

- 1. Compute solutions for large scale power systems using sparsity and optimal ordering schemes.
- 2. Analyze the power flow methods to find power flow solutions for various power networks.
- 3. Calculate the symmetrical and unsymmetrical fault parameters in typical power systems.
- 4. Carry out security assessment and enhancement procedures for various power networks.
- 5. Estimate the power system states using various techniques.

se Seference	(3/2/1 indicates COs Programm	CO/PO, PS the strength of corre e Outcomes (POs) an	O Mapping lation) 3-Strong, 2- d Programme Spec	Medium, 1-Weak ific Outcomes (PSOs)	8-1 (
COs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	3	3	3
CO2	2	3	3	3	3
CO3	2	3	3	3	3
CO4	2	2	3	3	3
CO5	3	3	3	3	3

#### **Course Assessment methods**

	Indirect	
CIE test I (10) (Theory) CIE test II (10) (Theory) CIE test III (10) (Theory)	Assignment / Problem –Solving /Seminar (10) Total CIE: <b>40 Marks</b> Semester End Examination : <b>60 Marks</b>	Course end survey

#### UNIT I SOLUTION TECHNIQUES

Sparsematrix techniques for large scale power systems- Optimally ordered Triangular Factorization-Triangular Decomposition- Gaussian Elimination- Triangular Decomposition of table of factors- Bifactorization method- Sparsity and Optimal Ordering schemes- Comparative advantages for a sparse matrix.

#### UNIT II POWER FLOW SOLUTIONS

Power flow equation for "n" bus system-Overview of Gauss seidel and Newton Raphson method- Fast Decoupled power flow method- Power flow studies in system design and operation-Regulating Transformers.

#### UNIT III FAULT ANALYSIS

Types of faults- Transient on power system components- Symmetrical fault analysis using bus impedance matrix – Concepts in symmetrical components of unsymmetrical phasors- Sequence networks for various power system components- Unsymmetrical fault analysis in power systems.

#### UNIT IV SECURITY ANALYSIS

Factors affecting power system security - Security state diagram- Security assessment using Linear sensitivity factors- Generation shift and Line-outage distribution factors- Contingency analysis using sensitivity factors- Security enhancement by preventive, emergency and restorative control.

## Regulations - 2023 Dr.S. PADMA, M.E., Ph.D., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu.

4.8.2023

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#### UNIT V STATE ESTIMATION

Introduction – Maximum Likelihood Weighted Least Squares Estimation-State Estimation of an AC network- State estimation by Orthogonal Decomposition algorithm- Detection and Identification of Bad measurements- Network Observability and Pseudo measurements- Application of power system state estimation.

#### Lecture: 45, Tutorial: 0, Total: 45 Hours

#### **REFERENCE BOOKS:**

- 1. John J. Grainger, William D. Stevenson, "Power System Analysis", Mc- Graw Hill, Reprint Edition, 2017.
- 2. Allen J Wood, Bruce F Wollenberg, "Power Generation and Control", John Wiley & Sons, New york, reprint edition, 2015.
- 3. M.A.Pai, "Computer Techniques in Power System Analysis", Tata McGraw- Hill publishing ltd, New Delhi, 2014.
- 4. P.Venkatesh, B.V.Manikandan, S.Charles raja and A.Srinivasan, "Electrical power systems-Analysis, security and Deregulation", PHI Learning Pvt Ltd, New Delhi, 2016.

Dr.S.PADMA, M.E., Ph.O., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu.

#### **ELECTRIC AND HYBRID VEHICLES**

#### P23PSE102

#### **COURSE OUTCOMES:**

At the end of the course, the students will be able to,

- 1. Explain the necessity of hybrid electric vehicle and to model vehicles for its performance analysis.
- 2. Illustrate the basic concepts of hybrid and electric drive train topologies and explain power flow control with fuel efficiency analysis.
- 3. Explain the configuration and control of various motor drives used in hybrid and electric vehicles and to elaborate on the energy storage requirements for the electric vehicles.
- 4. Compare the performance of electric motor with IC engine in order to select Electric drive and energy storage technology and to explain various vehicle communication subsystems.
- 5. Classify and compare different energy management strategies and list the issues pertaining to its implementation.

(	(3/2/1 indicates COs Programm	CO/PO, PS the strength of corre e Outcomes (POs) an	O Mapping lation) 3-Strong, 2-Me d Programme Specific	edium, 1-Weak c Outcomes (PSOs	)
COs	PO1	PO2	PO3	PO4	PO5
COI	t	1	3	3	3
CO2	2	2	3	3	3
CO3	2	2	3	3	3
CO4	2	2	3	3	3
CO5	2	3.	3	3.	3

Course Assessment methods

	Indirect	
CIE test I (10) (Theory) CIE test II (10) (Theory) CIE test III (10) (Theory) CIE test IV (10) (Laboratory)	Assignment /Quiz/Seminar/mini project (10) Total CIE: <b>50 marks</b> Semester End Examination: <b>50 marks</b> [SEE- Theory (35 marks),Lab (15 marks)]	Course end survey

#### UNIT I INTRODUCTION TO HYBRID ELECTRIC VEHICLE

History of hybrid and electric vehicles- social and environmental importance of hybrid and electric vehicles- impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics and mathematical models to describe vehicle performance.

# UNIT II HYBRID TRAIN ARCHITECTURES AND POWER FLOW MANAGEMENT

Fundamental concept of hybrid traction- introduction to various hybrid drive-train topologies power flow control in hybrid drive-train architectures- fuel efficiency analysis. Basic concepts of electric traction- introduction to various electric drive-train topologies- power flow control in hybrid drive - train topologies- fuel efficiency analysis.

#### UNIT III ELECTRIC PROPULSION AND ENERGY STORAGE

Introduction to hybrid and electric vehicles- Configuration and control of DC Motor drives -AC Motor drives- Permanent Magnet Motor drives- Switch Reluctance Motor drives and drive system efficiency.

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Sona College of Technology Salem-636 005. Tamil Nadux Energy storage requirements in Electric and Hybrid electric vehicles, Battery types, Properties of Batteries, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery Modeling - Run Time Battery Model, First Principle Model, Battery pack Design.

#### UNIT IV PERFORMANCE ANALYSIS AND VEHICLE COMMUNICATION SYSTEMS

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Matching the electric machine and the internal combustion engine (ICE)- Sizing the propulsion motorsizing the power electronics- selecting the energy storage technology. Communications supporting subsystems- Introduction to CAN, LIN, FLEXRAY, MOST, KWP 2000 - Details of CAN, Introduction to V2V, V2I systems.

#### UNIT V ENERGY MANAGEMENT STRATEGIES

Introduction to energy management strategies used in hybrid and electric vehicle- classification of different energy management strategies- comparison of different energy management strategies- implementation issues of energy strategies.

#### Lecture: 45, Tutorial: 0, Practical: 30, Total: 75 Hours

#### **REFERENCES BOOKS:**

- 1. Iqbal Husain, "Electric and Hybrid vehicles Design Fundamentals", CRC Press, second edition 2013.
- 2. James Larminie, John Lowry, "Electric Vehicle Technology Explained" second Edition, Wiley 2012.
- 3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
- 4. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013.

#### MODELLING AND SIMULATION OF EHV

#### Simulation Tool: MATLAB/Simulink.

List of Experiments:

- 1. Simulation for AC to AC conversion.
- 2. Simulation for AC to DC conversion.
- 3. Simulation for DC to DC conversion.
- 4. Speed control of DC motor using IGBT.
- 5. To perform speed reversal of DC shunts Motor.
- 6. Speed control of switched Reluctance Motor.
- 7. Speed control of BLDC Motor.
- 8. Simulation of four Quadrant operation of three phase Induction Motor.
- 9. PWM based Z source inverter.
- 10. V/f control of three phase induction motor.

John 4.9,

M.E – Power Systems Engineering.S.PADMA

Professor and Regulations - 2023 Department of EEE, Sona College of Technology Colem-636 005. Tamil Nadu.

#### P23PSE103 HIGH VOLTAGE AND INSULATION SYSTEMS

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#### **COURSE OUTCOMES:**

At the end of this course the students will be able to,

- 1. Describe the various insulating materials used in power system
- 2. Illustrate breakdown mechanism of solid, liquid and gaseous dielectrics
- 3. Explain the high voltage generation methods and measurements
- 4. Evaluate insulation testing of electrical equipments
- 5. Describe the various Non-destructive testing in high voltage.

kan diti na l	(3/2/1 indicates COs Programm	CO/PO, PS the strength of correct e Outcomes (POs) and	SO Mapping elation) 3-Strong, 2-M nd Programme Specif	fedium, 1-Weak ic Outcomes (PSOs)	
COs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3 4	3
CO2	2	3	3	3	3
CO3	2	2	3	3	3
CO4	2	3	3	3	3
CO5	2	3	3	3	3

#### **Course Assessment methods**

Direct		Indirect
CIE test I (10) (Theory) CIE test II (10) (Theory) CIE test III (10) (Theory)	Assignment / Problem –Solving /Seminar (10) Total CIE: 40 Marks Semester End Examination : 60 Marks	Course end survey

#### UNIT I INSULATING MATERIALS IN POWER SYSTEM

Review of insulating materials Gases, Vacuum, liquids and solids- characterization of insulation condition – permittivity, capacitance, resistivity and insulation resistance, dielectric dissipation factorspartial discharges sources, forms and effects- ageing effects- electrical breakdown and operating stresses- standards relating to insulating materials.

## UNIT II BREAKDOWN MECHANISMS OF SOLID, LIQUID AND GASEOUS DIELECTRICS

Introduction to insulation systems used in high voltage power apparatus - breakdown mechanisms of solid, liquid, gas and vacuum insulation.

## UNIT III BASIC METHODS OF GENERATION AND MEASUREMENT OF TEST HIGH VOLTAGES

Generation of high alternating voltages: cascaded transformers and series resonant circuit- Generation of high dc voltages: rectifier circuit and voltage multiplier circuit- Generation of impulse voltages: multistage impulse generator circuit- Generation of impulse currents – Measurement of high ac, dc and impulse voltages: voltage divider circuits- Digital Storage Oscilloscope for impulse voltage and current measurements.

#### UNIT IV INSULATION TESTING OF ELECTRICAL EQUIPMENTS

Necessity for high voltage testing - testing of distribution and power transformers - voltage transformers - current transformers - bushings - overhead line and substation insulators - surge arresters - high voltage cables - circuit breakers and isolators - IEC and Indian standards.

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#### UNIT V NON-DESTRUCTIVE TESTING

Insulation resistance measurement- Measurement of tan delta and capacitance of dielectrics - grounded objects like transformers and alternators – Measurement of Partial discharges - location and measurement of discharges in electrical equipment –Dissolved gas in oil measurement.

Lecture: 45, Tutorial: 0, Total: 45 Hours

#### **REFERENCE BOOKS:**

- 1. Naidu, M.S. and Kamaraju, V., High Voltage Engineering, Tata McGraw Hill Publishing Company Ltd., New Delhi, 5<sup>th</sup> edition, 2013.
- 2. R.E.James and Q.Su, Condition Assessment of High Voltage Insulation in Power System Equipment, IET Power and Energy Series 53, 2008.
- 3. Adrianus, J. Dekker, Electrical Engineering Materials, Prentice Hall of India Pvt. Ltd., New Delhi, 1979.
- 4. Gallagher, T.J., and Permain, A., High Voltage Measurement, Testing and Design, John Wiley Sons, New York, 1984.

DMA, M.E., Ph.D., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu

#### P23PSE104 ADVANCED POWER SYSTEM SIMULATION LABORATORY 00402

#### **COURSE OUTCOMES:**

At the end of this course, the students will be able to,

- 1. Compute load flow, contingency economic dispatch and unit commitment solutions for various power systems.
- Analyze different power systems by carrying out various short circuit and state estimation techniques.
- 3. Model and simulate AGC and AVR systems for given power system.

(All simulation shall be performed using suitable simulation softwares).

)* +6 = 1 = 1	(3/2/1 indicates	CO/PO, PS the strength of corre	O Mapping lation) 3-Strong, 2-M	fedium, 1-Weak	
COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3

#### **Course Assessment methods**

	Direct	Indirect
CIE test I (20) Quiz 1 (5)	RTPS (10) Total CIE: <b>60 marks</b>	
Quiz 2 (5)	Semester End Examination: 40 marks	Course end survey

#### LIST OF EXPERIMENTS

- 1. Load flow analysis by Newton-Raphson method
- 2. Load flow analysis by Fast decoupled method
- 3. Contingency analysis: to calculate sensitivity factors.
- 4. Economic dispatch using lambda-iteration method
- 5. Unit commitment: Priority-list schemes and dynamic programming.
- 6. Short circuit analysis in power system.
- 7. State estimation of power system network
- 8. Automatic Generation control for power system network
- 9. Familiarization of Relay Test Kit
- 10. Modeling and Simulation of AVR.

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M.E – Power Systems Engineering

**Regulations - 2023** 

#### **POWER QUALITY**

#### P23PSE501

#### **COURSE OUTCOMES:**

At the end of this course the students will be able to.

- 1. Describe the basic power quality issues.
- 2. Discuss about voltage related problems.
- 3. Evaluate harmonics in power system due to power electronic devices.
- 4. Evaluate power quality using measuring equipment.
- 5. Improve the power quality using different types of filters.

		CO/PO, PS	O Mapping		
	(3/2/1 indicates	the strength of corre	lation) 3-Strong, 2-N	ledium, 1-Weak	
	COs Programm	e Outcomes (POs) an	d Programme Specif	ic Outcomes (PSOs)	
COs	PO1	PO2	PO3	PO4	PO5
CO1	1	1	3	3	3
CO2	1	1	3	3	3
CO3	2	3	3	3	3
CO4	2 3		3	3	3
CO5	3	3	3	3	3
		Course Assess	ment methods		L

	Direct       test I (10) (Theory)     Assignment / Problem – Solving /Seminar       test II (10) (Theory)     (10)       test III (10) (Theory)     Total CIE: 40 Marks       Semester End Examination - 60 Marks	Indirect
CIE test I (10) (Theory) CIE test II (10) (Theory) CIE test III (10) (Theory)	Assignment / Problem –Solving /Seminar (10) Total CIE: <b>40 Marks</b> Semester End Examination : <b>60 Marks</b>	Course end survey

#### UNIT I **INTRODUCTION**

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Power quality, Voltage quality - power quality evaluation procedure - overview of power quality phenomena - classification of power quality problems - power quality measures and standards - THD-TIF-DIN-C-message weights – flicker factor – occurrence of power quality problems – power acceptability curves - overview of EMC and IEEE standards.

#### UNIT II **VOLTAGE SAGS AND INTERRUPTIONS**

Long Interruptions: Causes - generation, transmission and distribution reliability - basic concepts of reliability evaluation techniques - costs.

Short Interruptions: Origin - influence on motors and electronic equipment - single phase tripping. Sags: Introduction - sag magnitude, duration - load influence on voltage sags - sags in adjustable speed AC and DC drives.

#### **UNIT III** HARMONIC DISTORTION

Harmonic distortion - harmonics versus transients - harmonic indices - harmonic sources from commercial and industrial loads - locating harmonic sources - SMPS - Three phase power converters - arcing devices - Harmonic Distortion of fluorescent lamps - effects of harmonic distortion - interharmonics – principles for controlling harmonics –devices for controlling harmonic distortion.

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#### UNIT IV POWER QUALITY MONITORING

Monitoring considerations –power quality measurement equipment – power quality data assessment – basic design of an expert system for monitoring applications – power quality monitoring in internet.

### UNIT V POWER QUALITY IMPROVEMENT

Static compensator – Distribution static compensator – Dynamic voltage restorer – Power factor corrector – Active filters – Shunt active filters – applications – PSCAD / EMTDC – simulation of Active filters.

#### Lecture: 45, Tutorial: 0, Total: 45 Hours

#### **REFERENCE BOOKS:**

- Math H.J. Bollen, "Understanding Power Quality Problems: Voltage sags and interruptions", IEEE press, 2011.
- Roger C. Dugan, "Electrical power Systems Quality", McGraw Hill Education, Third edition, 2012.
- 3. Arrillaga J, Watson NR, Chen S, "Power System Quality Assessment", John Wiley & Sons, 2011.
- 4. Heydt G T, "Electric Power Quality", Stars in a Circle Publications, 1991.

round . 8.2 Dr.S.PADMA, M.E., Ph.D., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu.

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#### **COURSE OUTCOMES:**

At the end of the course, the student will be able to

- 1. Review the literature of the research problem
- 2. Choose appropriate data collection and sampling method according to the research problem.
- 3. Interpret the results of research and communicate effectively with their peers
- 4. Explain the Importance of intellectual property rights
- 5. Evaluate trade mark, develop and register patents.

et to kan an	(3/2/1 india COs Progra	CO/PO, PSO Mapping 3/2/1 indicates the strength of correlation) 3-Strong, 2-Medium, 1-Weak Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)					
COs	PO1	PO2	PO3	PO4	PO5		
CO1	2	3	3	3	3		
ÇQ2	2	3	3	3	3		
CO3	2	3	3	3	3		
CO4	2	3	3	3	3		
CO5	3	3	3	3	3		

#### **Course Assessment methods**

	Direct					
CIE test I (10) (Theory) CIE test II (10) (Theory) CIE test III (10) (Theory)	Assignment / Problem –Solving /Seminar (10) Total CIE: 40 Marks Semester End Examination : 60 Marks	Course end survey				

#### UNIT I INTRODUCTION TO RESEARCH METHODS

Definition and Objective of Research, Various steps in Scientific Research, Types of Research, Criteria for Good Research, Defining Research Problem, Research Design, Case Study Collection of Primary and Secondary Data, Collection Methods: Observation, Interview, Questionnaires, Schedules,

#### UNIT II SAMPLING DESIGN AND HYPOTHESIS TESTING

steps in Sampling Design, Types of Sample Designs, Measurements and Scaling Techniques -Testing of hypotheses concerning means (one mean and difference between two means -one tailed and two tailed tests), concerning variance — one tailed Chi-square test.

#### UNIT II INTERPRETATION AND REPORT WRITING

Techniques of Interpretation, Precaution in Interpretation, Layout of Research Report, Types of Reports, Oral Presentation, Mechanics of Writing Research Report

#### UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights, Innovations and Inventions trade related intellectual property rights.

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PG Regulations - 2023

#### UNIT V TRADE MARKS, COPY RIGHTS AND PATENTS

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Purpose and function of trade marks, acquisition of trade mark rights, trade mark registration processes, trademark claims —trademark Litigations- International trademark law Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

#### Lecture: 45, Tutorial: 0, Total: 45 Hours

#### **TEXT BOOKS**

- 1. C.R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques An Edition, New Age International Publishers, 2019.
- 2. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets", Delmar Cengage Learning, 4" Edition, 2012.
- 3. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", Tata Mc Graw Hill Education, 1" Edition, 2008.

#### **REFERENCE BOOKS**

- 1. Panneerselvam, R., Research Methodology, Second Edition, Prentice-Hall of India, New Delhi, 2013.
- 2. Ranjith Kumar, Research Methodology A step by step Guide for Begineers, 4" edition, Sage publisher, 2014.
- 3. D Llewelyn & T Aplin W Cornish, "Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights", Sweet and Maxwell, 1" Edition, 2016.
- 4. Ananth Padmanabhan, "Intellectual Property Rights-Infringement and Remedies", Lexis Nexis, 1" Edition, 2012.
- 5. Ramakrishna B and Anil Kumar H.S, "Fundamentals of Intellectual Property Rights: For Students, Industrialist and Patent Lawyers", Notion Press, 1" Edition, 2017.
- 6. M.Ashok Kumar and Mohd. Iqbal Ali :"Intellectual Property Rights" Serials Pub

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Dr.S.PADMA, M.E., Ph.D., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu.

P23G	E701	English for	Research Paper Writi	ng	L		T         P         J           0         0         0		C
			Research raper with	"5	2	0			0
Course (	Dutcomes						1		
At the er	nd of the cour	se, the student wi	ll be able to						
CO1:	Demonstrat	e research writing	skills both for research a	irticles and	thesis				
CO2:	Frame suita	ble title and caption	ons as sub-headings for a	rticles and	thesis				
CO3:	Write each	section in a resear	ch paper and thesis coher	rently			×		
CO4:	Use langua	ge appropriately a	nd proficiently for effecti	ve written	comm	unicatio	on		
CO5:	Exhibit pro	fessional proof-rea	ding skills to make the v	vriting erro	or free			I.	
		(	Course Assessment meth	ods					
		Direc	ŧ				Indired	:t	
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CIE test l	II (30)		Semester End Examina	tion: NIL		Cour	se end	survev	
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nit 02:	ng research find	lings, understanding	avoiding redundancy, and	paraphrasin	2 sectio	ons of a	6 paper/a	Hours	
<b>Interpretin</b>	ng research find	lings, understanding	avoiding redundancy, and	paraphrasin	g sectio	ons of a	6 paper/ a	Hours	
Unit 02: Interpretin Unit 03:	ng research find	lings, understanding	a and avoiding plagiarism, p	paraphrasin	g sectio	ons of a	6 paper/ a	Hours bstract. Hours	
J <b>nit 02:</b> Interpretin J <b>nit 03:</b> Key skills	ng research find	lings, understanding e, to draft an abstrac	avoiding redundancy, and and avoiding plagiarism, p t, to give an introduction	paraphrasin	g sectio	ons of a	6 paper/ a 6	Hours bstract. Hours	
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Dr. M.RENUGA, Professor & Head, Department of Humanities & Languages, Sona College of Technology, SALEM - 61

Programme: M.E / M. Tech

M.E / M.. Tech Regulations 2023

# Sona College of Technology, Salem (An Autonomous Institution) Courses of Study for M.E /M.Tech. Semester II under Regulations 2023 (CBCS) **Branch: Power Systems Engineering**

S.No	Course Code	<b>Course</b> Title	L	T	P	J	C	Category	Total Contact Hours	Course Type*
		Theory cour	rses							
1.	P23PSE201	Modern Power System Protection	3	0	2	0	4	PC	75	TL
2.	P23PSE202	Power System Dynamics and Stability	3	0	0	0	3	PC	45	Т
3.	P23PSE203	Restructured Power Systems	3	0	0	0	3	PC	45	T.
4.	P23PSE506	Elective: Smart Grid	3	0	0	0	3	PE	45	Т
5.	P23PSE511	Elective: Industrial Automation	3	0	0	0	3	PE	45	Т
6.	P23GE702	Audit Course: Stress Management by Yoga	2	0	0	0	0	AC	30	Т
		Practical cou	rses							
7.	P23PSE204	Power Electronics Applied to Power Systems Laboratory	0	0	4	0	2	PC	60	L
8.	P23PSE205	Automation Laboratory	0-	0	4	2	3	PC	90	LP
		Total Credits	2				21	ł		

\*T- Theory, TT- Theory with Tutorial, TL- Theory with Laboratory, TP- Theory with Project, TLP- Theory with Laboratory and Project, L-Laboratory, LT- Laboratory with Theory, LP- Laboratory with Project

#### **Approved By**

S. Padrie	Mirakunar	J. dulano >	
Chairperson, Electrical and Electronics Engineering BoS	Member Secretary, Academic Council	Dean-Academics	Chairperson, Academic Council & Principal
UI.S. PATS Badma	Dr.R.Shivakumar	Dr.J.Akilandeswari	Dr.S.R.R.Senthil Kumar

Professor and Head,

Department of EEE,

Sona College of Technolog Salopy 696 005. Tamil Nad HOD/EEE, Second Semester M.E -PSE Students and Staff, COE

P23PSE201 MO		MOE	DERN POWER SYSTEM P	ROTECTION	L	T	Р	J	C		
				n ann an Arthreite	3	0	2	0	4		
Course (	Jutcomes			<u></u>			1	t en s			
At the er	nd of the co	ourse, the s	tudent will be able to								
CO1:	Describe	the protect	tion schemes for power sys	tem equipment.		let i de					
CO2:	Explain	xplain static relays and their characteristics.									
CO3:	Discuss	cuss different digital protection scheme.									
CO4:	Illustrate	modern tre	ends in protective relaying.	a an tha the second					1		
CO5:	Evaluate	various rel	ay testing methods.								
Pre-requ	isite:					·			4 		
A GAN DI	Protectio	n and Swite	chgear			na da Natira			1		
			CO/PO, PSO M	lapping	¢						
		(3/2/1 indic	ates the strength of correlati	on) 3-Strong, 2-M	ledium, :	L-Weak					
COs	F	Programme	Outcomes (POs) and Program	nme Specific Outo	comes (P	SOs)					
		PO1	PO2	PO3	PO	4		PO5			
CO1		3	3	3	3	199 - 199 - 199 19		3			
CO2		3	3	3	3	l i sin		3			
.603		3-	3-	3	3	t an anh	61.20	3-			
C04		3	3	3	3			3			
05		3	3	3	3			3			
An			Course Assessmen	nt methods					-		
			Direct				Indirec	t-	27465 		
CIE test I	(10) - Theo	ory	Assignment /Quiz/Sem	inar/mini projec	ť						
CIE test II	(10) - The	ory	(10) Total CIE: 50 mark	s Semester End		Cours	o and a	11471-011			
CIE test II	I (10) - The	eory	ISEE Theory (25 merles	AT-1 (15 1 )		Cours	e enu s	urvey			
CIE test IV	V (10) - Lab	oratory	[SEE- Theory (SS marks	s),Lab (15 marks)							
nit 01: IN	TRODUC	TION	S.PADMA, MI. Phil	s ()			9	Hours			
General p Fransmiss	hilosophy ion lines, 7	of protecti Fransforme	on – Characteristic functions, Generators, Motors – Bu	ons of protective us bar protection	relays – Back	<ul> <li>Prote</li> <li>up prote</li> </ul>	ction section.	chemes	s foi		
nit 02: ST	ATIC RE	LAYS AN	D THEIR CHARACTER	ISTICS			9	Hours			
tatic rela	ays – Am	plitude con	mparator, phase comparat	tor – Static Ov	er curre	ent rela	v - Sv	nthesi	s of		
mpedance elay.	e relay, MI	HO relay, R	Reactance relay, Quadrilate	ral relay, and Di	fferentia	l relay	- Static	freque	ency		
nit 03: DI	GITAL PI	ROTECTI	ON				9	Hours			
lumerical	relay - S	ampling fre	equency – Digital signal pr	rocessing - Digi	tal filter	ing in r	rotectiv	ve rela	vs –		
telays alg elay - Qu	orithms – adrilateral	Over curre relay.	ent relays, Directional rel	lay, Impedance	relay,	MHO r	elay , I	Differe	ntial		
		·			Del	DAD	MAN	E. Ph.	D.,		
12	1 2024 1	amina IA	ME D. C. D.	·	"DI.	FAL	IVAL A, IV	h			
12.	1.2024 V	ersion I.O	M.E. – Power Systems Engi	neering Semester	II PC	Resist Departm	eren202	Bead, EEE,			

#### 12.1.2024 Version 1.0 M.E. - Power Systems Engineering Semester II PG Regulations 2023

**Unit 04: MODERN TRENDS IN PROTECTIVE RELAYING** 

Carrier current pilot relaying - Phase comparison, carrier Aided distance protection - Travelling wave relays - Amplitude comparison relay, phase comparison relay - Fiber optic based relaying - SCADA architecture - Use of SCADA in interconnected power systems - PLC and DCS control.

## Unit 05: TESTING OF PROTECTIVE SYSTEMS AND ADAPTIVE PROTECTION

Testing of protective current and potential transformers - Testing of relays - primary and secondary injection tests - Relay burden - Relay setting - Relay co - ordination - Fault locators - Adaptive protection - Fault analysis - Adaptive techniques - Intelligent Electronics devices.

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Th	eory: 45 Hrs	Tutorial:	Project:	Total Ho	urs: 75 Hrs							
REFE	REFERENCES											
1.	1. Y.G .Paithankar, S.R.Bhide, "Fundamentals of Power System Protection". Prentice – Hall India, 2004											
2.	Badri Ram and D.N. Vishwakarma, "Power System Protection and Switch Gear" Tata McGraw Hill, New Delhi, 2003											
3.	Ravindra P.Sing	gh, "Digital Powe	er System Protection",	PHI, New Delhi,	2007.							
4.	T.S.M.Rao , "D	igital / Numerica	l Relays" Tata McGra	w Hill, 2005.								

## List of Experiments

- 1. Stimulate a fault and analyse the functions of power system using relay.
- 2. Stimulation of bus bar protection using differential relay.
- 3. Stimulation of zone protection for transmission line.
- 4. Time line characteristics of MCB and MCCB.
- 5. Parallel operation of alternators using synchronization relay.
- 6. Testing of transformer oil break down voltage (BDV)
- 7. Determination of various parameters of contactors and relays.

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9 Hours

9 Hours

P23	PSE202	POWER SYSTEM	DYNAMICS AND	L	T	P	J	C
		STAI	BILITY	3	0	0	0	3
Course (	Dutcomes						l	
At the er	nd of the cour	se, the student will be al	ole to					
CO1:	Analyze the	mathematical modeling	and inductance calcula	tions in syn	chronou	is mach	ine.	ning in Selfine
CO2:	Develop the	transfer function model	for excitation, speed go	overning an	d turbin	e syster	ns.	
CO3:	Analyze the	small signal stability of t	SMIB power systems.					
CO4:	Analyze the controllers.	e small signal stability o	of SMIB and Multi-m	achine pov	ver syst	ems wi	th dan	npin
CO5:	Describe fee	edback controllers for sm	all signal stability enha	incement in	power	systems	nistrik.	in and
Pre-requ	isite:				<u>pe</u>		•	
	Power Syste	em Analysis, Control Syst	ems			ing diala		n ser de Sector
	1991 - 1180 - 11	CO/P	O. PSO Manning		1.24× 10		din artis	
	(3/2/	l indicates the strength of	f correlation) 3-Strong.	2-Medium	1-Wea	k		
COs	Pro	gramme Outcomes (POs) a	nd Programme Specific (	Dutcomes (P	SOs)	<u></u>	<u>eren konstans</u>	
	PO1	PO2	PO3	PO4	PO5			
CO1	3	3	3	3		3		-
CO2	3	3	3	3		3		
CO3	3	3	3	3	V. News	3		
CO4	3	3	3	3	an fan en de skiert an de seren en de s	3		
CO5	3	3	3	3		3		
		Course A	ssessment methods			28		
		Direct				Indirec	t	
CIE test I	(10)	Assignment / Pro	blem- solving /					
CIE test I	I (10)	Seminar (10)	an a		C	ourse en	nd	
CIE test I	II (10)	Total CIE: 40 ma	rks			survey		
		Semester End Exa	amination: 60 marks					
nit 01: SY	NCHRONO	US MACHINE MODEI	LING			9	Hours	
<b>Aathemat</b>	tical Descripti	ion of a Synchronous M	achine: Basic equation	ns of a syn	chrono	us mac	nine: s	tato
ircuit eq	uations, stator	self, stator mutual and s	tator to rotor mutual i	nductances.	da0 Tr	ansform	nation.	flux
nkage ar	nd voltage equ	ations for stator and rote	or in dg0 coordinates.	electrical n	ower at	nd toran	e. Phy	sica
aterpreta	tion of dq0	transformation, Per I	Jnit Representations-	Power-in	variant	form	of P	ark'
ansform	ation_Steady s	tate analysis: Voltage ou	ment and flux linkage	rolationshim	a Cam		C .	

state values.

Unit 02: MODELLING OF EXCITATION AND SPEED GOVERNING SYSTEMS 9 Hours

Elements of an Excitation System, Types of Excitation Systems- Modeling of Excitation system components, Modeling of IEEE type ST1A Excitation system model, Turbine and Governing System Modeling- Classical transfer function of a hydraulic turbine (no derivation), Special characteristics of hydraulic turbine, Electrical analog of hydraulic turbine, Governor for Hydraulic Turbine: Requirement for a

12.1.2024 Version 1.0 M.E. – Power Systems in Semicar Market Philos PG Regulations 2023 Professor and Head, Department of EEE,

Sona College of Technology Salem-636 005. Tamil Nadu. transient droop, Block diagram of governor with transient droop compensation,: Modeling of Single reheat tandem compounded type Steam Turbine.

Unit 03: SMALL SIGNAL STABILITY ANALYSIS WITHOUT CONTROLLERS 9 Hours

Classification of Stability- State- Space representation- Eigen properties of state matrix: Eigen values and Eigenvectors for stability, Participation factor. Single Machine Infinite Bus (SMIB) Configuration: Classical Machine Model stability analysis- Effects of Field Circuit Dynamics- Block diagram representation with K-constants; expression for K-constants (no derivation), effect of field flux variation on system stability.

# Unit 04: SMALL SIGNAL STABILITY ANALYSIS WITH CONTROLLERS

Effects of Excitation System: Thyristor Excitation System with AVR, Block diagram representation with Exciter and AVR, Effect of AVR on Synchronizing and Damping torque components, Power System Stabilizer: Block diagram representation with AVR and PSS, System state matrix including PSS- Small Signal Stability of Multi machine systems.

# Unit 05: ENHANCEMENT OF SMALL SIGNAL STABILITY

9 Hours

9 Hours

Power System Stabilizer – Stabilizer based on shaft speed signal (delta omega) – Delta P-Omega stabilizer-Frequency-based stabilizers – Digital Stabilizer – Excitation control design – Exciter gain – Phase lead compensation – Stabilizing signal washout and stabilizer gain – Stabilizer limits, Selection of PSS location.

Th	eory: 45 Hrs	Tutorial:	Practical:	Project:	Total Hours: 45 Hrs						
REFE	RENCES										
1.	1. Prabha Kundur, "Power System Stability and Control", Tata McGraw-Hill, 2014.										
2.	2. J.Machowski, Bialek, Bumby, "Power System Dynamics and Stability", John wiley and sons, 2011.										
3.	3. L.Leonard Grigsby, "Power System Stability and Control", CRC Press, 2017.										
4.	<ol> <li>Peter W.Sauer &amp; M.A.Pai, "Power System Dynamics &amp; Stability", Pearson Education, 2006.</li> </ol>										

Dr.S.PADMA, M.E., Ph.D., Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nad

PG Regulations 2023

P23	PSE203	R	ESTRUCTURED PO	WER SYSTEMS		T	P	J	C
Course (	Jutcome				3	0	0	0	3
		Geographia	ender all strate fragmente son						
At the er	d of the	course, the	student will be able	to					
CO1:	Discus	s the need	for restructuring of pov	ver industry and marke	et model	S			
CO2:	Explain	n the basics	of congestion manage	ement	1,3,572	404 -		i dana	<u>14</u>
CO3:	Discus	s about loc	ational margin prices a	nd financial 21 transm	ission ri	ghts			<u>.</u>
CO4:	Explain	n the signif	icance of ancillary serv	vices and pricing of tra	nsmissio	n netwo	ork		 
CO5:	Elabora	ate the refo	rms of power sectors i	n India	<del>tanà katèn n</del> Désidén dia k				
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919).	Power	system ope	ration and control	in the state of th	age des				
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CUS		Programm	Programme Specific C	Jutcomes	(PSOs)	1	DOF		
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CO3	1.11.17.1.46	3	3	3	3		2		
CO4		3	3	3	3		3		-
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CIE test I CIE test I CIE test I	(10) I (10) II (10)		Assignment / Problem Seminar (10) Total CIE: 40 marks Semester End Exami	m- solving / nation: 60 marks		C	ourse e survey	nd	
nit 01: IN	TRODU	CTION T	O RESTRUCTURIN	G OF POWER INDU	JSTRY		9	Hours	
ntroducti Deregulat Dehavior, Market m - vis othe	on: Dere ion of v Market odels bas r commo	egulation of various po- equilibrium sed on Con- dities, Mar	of power industry, Rewer systems – Funda n, Short and long run ractual arrangements, whet architecture, Case s	estructuring process, imentals of Economi costs, Various costs Comparison of various study	Issues cs: Cons of prod s market	involved sumer l luction models	d in de behavio – Mark , Electri	eregula r, Sup cet mo icity vi	ntion oplie dels s –
nit 02: Tl	RANSMI	ISSION CO	<b>DNGESTION MANA</b>	GEMENT			. 9	Hours	
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				Dr.S.	PADM	, M.E.,	Ph.D.,		
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Sona College of Technology Salem-636 005. Tamil Nadu,

Unit 0. TRAN	3: LOCATIONAL MARGINA	L PRICES AND FIN	ANCIAL		9 Hours
Math	ematical preliminaries: - Locati	anal marginal priving	Localoga DCODE		
Loss	compensated DCOPF model for	or I MP colculation	ACODE model for 1		MP calculation -
Trans	mission rights - Risk hedging	functionality Simult	ACOLL HINDREY HOLD	LIVIP calcu	lation – Financial
FTR	issuance process: FTR auction	FTR allocation Treas	mont of revenue abo	st and reve	nue adequency –
FTRs	<ul> <li>Flow gate rights – FTR and n</li> </ul>	narket power - FTR an	d merchant transmiss	sion investr	nent.
Unit 04	ANCILLARY SERVICE M	ANAGEMENT AND	PRICING OF		0 Hours
IKAN	SMISSION NETWORK				7 Hours
Introc	luction of ancillary services – T	ypes of Ancillary servi	ces - Classification	of Ancillar	y services - Load
gener	ation balancing related service	s - Voltage control at	nd reactive power su	upport devi	ces - Black start
capab	ility service - How to obtain	ancillary service -Co-	optimization of en	ergy and r	eserve services -
Trans	mission pricing - Principles -	Classification - Roll	ed in transmission	pricing met	thods - Marginal
transn	nission pricing paradigm – Com	posite pricing paradigr	n – Merits and deme	rits of diffe	erent paradigm.
Unit 05	: REFORMS IN INDIAN PO	WER SECTOR			9 Hours
Introd	luction – Framework of Indian p	ower sector - Reform	initiatives - Availab	ility based	ariff – Electricity
act 20	03 - Open access issues - Powe	er exchange – Reforms	in the near future.	กรณีการสูกรร์ไ	
Th	eory: 45 Hrs Tutorial:	Practical:	Project:	Total F	lours: 45 Hrs
REFE	RENCES		· · · · · · · · · · · · · · · · · · ·	and the second	
1.	Mohammad Shahidehpour, M	Iuwaffaq Alomoush, I volatility" CRC Pres	Marcel Dekker, "Re	estructured	electrical power
	Systems. operation, dualing and		3, 2001.		
2.	Kankar Bhattacharya, Jaap E. Kluwer Academic, 2001.	Daadler, Math H.J. Bo	olen, "Operation of 1	restructured	power systems",
2.	Kankar Bhattacharya, Jaap E. Kluwer Academic, 2001. Sally Hunt, "Making competiti	Daadler, Math H.J. Bo	olen, "Operation of r	cestructured	power systems",
2. 3. 4.	Kankar Bhattacharya, Jaap E. Kluwer Academic, 2001. Sally Hunt, "Making competiti Steven Stoft, "Power system ed 2002.	Daadler, Math H.J. Bo ion work in electricity" conomics: designing m	John Willey and Scarkets for electricity	restructured ons Inc, 200 ", John wild	power systems", 02. ey and sons

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CO1:	Distinguish b	etween	smart grids v	with conventional	grid and expla	in the o	peration	s of Mi	cro gri	d.
CO2;	Apply moder analytics.	m comm	nunication te	chnologies and o	liscriminate cl	nallenge	es on sn	nart gri	d with	dat
CO3:	Illustrate the installations.	smart 1	metering and	l sensing concep	ts on smart g	rids to	industri	al and	comme	erci
CO4:	Explain the cissues in sma	lemand rt grid.	response ma	nagement system	and Formula	te solut	ions for	the po	wer qu	lalit
Ç <u>0</u> 5:	Apply the sn renewable en	nart gric ergy sys	l system for tem Formula	real time simula te solutions for th	tion case stud	ies of s	Substations in smar	on auto	mation	ı an
Pre-req	uisite:				1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	<u>,</u>		u giru.	-	
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nit 02: C	OMMUNICAT	ΓΙΟΝ ΤΙ	ECHNOLOG	IES & DATA AN	ALYTICS			9	Hours	
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arning	for Smart grid	applicat	tions.			00	man	~		
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# Unit 03: SENSING, MEASUREMENTS, CONTROL AND AUTOMATION 9 Hours 9 Hours

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, Smart Parks.

# Unit 04: DEMAND RESPONSE MANAGEMENT & POWER QUALITY IN SMART GRID

9 Hours

9 Hours

Energy efficiency, Energy Conservation, Demand response and HEMS, Power Quality issues of Grid connected Renewable Energy Sources -Power Quality Conditioners for Smart Grid - Web based Power Quality monitoring, Power Quality Audit- Phasor Measurement Units and applications- Geographical Information System.

## Unit 05: HIL SIMULATIONS & CASE STUDIES

Introduction to EMS and SCADA, RTU, IED, protocols and operations

Case studies: Substation automation, Electric vehicles using Smart Grid, Energy storage systems in Smart grid, Demand response management, Integration of renewable energy system and Power quality management systems using Smart Grid.

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Th	eory: 45 Hrs	Tutorial:	Practical:	Project:	Total Hours: 45 Hrs						
REFE	RENCES	Large parts and the second									
1.	Uma Rao and	Prema V "Sma	rt Grid An Indian	Adaptation Funda	mentals Design Technology						
	Applications Communication and Security", Wiley, 2021.										
2.	Lisa Ann Lamont and Ali Sayigh, "Application of Smart Grid Technologies Case Studies in Saving										
	Electricity in D	ifferent Parts of th	e World", Academic	Press, 2018.							
3.	Saurabh Mani	Tripathi, Francisc	o M. Gonzalez-Lon	gatt, "Real-Time	Simulation and Hardware-in-						
x 12 - 14	the-Loop Testin	the-Loop Testing Using Typhoon HIL", Springer, 2023.									
4.	Kenneth C. Bud	lka, Jayant G. Des	hpande, Marina Tho	ttan, 'Communicat	ion Networks for Smart						
	Grids', Springer	r, 2014.									

. Yoan Dr.S.PADMA, M.E., Ph.L Professor and Head, Department of EEE, Sona College of Technology Salem-636 005. Tamil Nadu

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course o	unomes						1			
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CO1:	Explain	the funda	imentals	of PLC and its ha	ardware.					
CO2;	Discuss 1	the variou	us instru	ctions involved in	n PLC Programm	ing languag	ge.		in Sala Salah	
CO3:	Identify	the Senso	ors and 7	Actuators for the v	various Industrial	application	IS.			
CO4:	Select the	e Comm	unication	n techniques for r	eal time application	ions.				
CO5:	Describe	the featu	ires of S	CADA and its co	mponents.	di sa ka s				
're-requi	site:									
	Electrical	Machines	, Embed	ded systems						
				CO/PO, P	SO Mapping					
		(3/2/1 in	dicates t	he strength of cor	elation) 3-Strong	2-Medium,	1-Weak			
COs	Pro	ogramme	Outcom	es (POs) and Progr	amme Specific Ou	itcomes (PSC	)s)			
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CO2		3	the beauty of	3	3	3	2	10 <sup>11</sup>	3	
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IE test II	(10)		Total	CIE: 40 marks			survey			
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it 01: IN	<b>FRODUC</b>	TION TO	INDUS	TRIAL AUTOMA	TION			9	Hours	
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Unit 04	4: PLC COMMUN	NICATION DEVI	<b>CES AND APPLICA</b>	TIONS	9 Hours			
Netwo Contr inspec	orking of PLC – I olling a Robot wi ction, Traffic light	Field bus – PROFI th PLC, Conveyor control system, A	bus – Mod bus – Con belt motor control, A pplication of PLC in p	ntrol Net, Device Net Automatic car washi power plants.	et and PROFI Net protocols. ing machine, PLC in quality			
Unit 05	5: SUPERVISOI	RY CONTROL A	ND DATA ACQUI	ISITION	9 Hours			
Introc Archi Trenc	duction - Evaluat tecture - Compo l on line, off line,	tion of SCADA - nents of SCADA HMI and Introdu	<ul> <li>Interfacing PLC v</li> <li>Master Terminal</li> <li>ction to DCS.</li> </ul>	vith SCADA – Fe Unit - Remote Ter	atures of SCADA –SCADA minal Unit - Alarm logging,			
Theory: 45 Hrs Tutorial: Practical: Project: Total Hours: 45 Hrs								
	101y. 45 ms	1 utorial:	Practical:	Project:	Total Hours: 45 Hrs			
REFE	CRENCES	1 utoriai:	Practical:	Project:	Total Hours: 45 Hrs			
<b>REFF</b> 1.	CRENCES Madhuchhanda Automation, Ar	Mitra, Samarjit	Practical: Sen Gupta, "Pro nram Interactional P	grammable Logic	Total Hours: 45 Hrs Controllers and Industrial 2012			
<b>REFF</b> 1. 2.	CRENCES Madhuchhanda Automation, Ar K. L.S. Sharma Controllers", M	Mitra, Samarjit Introduction" Per Overview of Ind cGraw Hill Inc., S	Practical: Sen Gupta, "Pro nram Interactional P lustrial Process Auto second Edition, 2011	Project: grammable Logic ublishing Limited, 2 pmation, Elsevier, F	Total Hours: 45 Hrs Controllers and Industrial 2012 Batten G. L., "Programmable			
<b>REFF</b> 1. 2. 3.	CRENCES Madhuchhanda Automation, Ar K. L.S. Sharma Controllers", M Stuart A Boyer,	Mitra, Samarjit Introduction" Per Overview of Ind cGraw Hill Inc., S "SCADA supervi	Practical: Sen Gupta, "Pro nram Interactional P dustrial Process Auto second Edition, 2011 isory control and data	Project: grammable Logic ublishing Limited, 2 omation, Elsevier, F - a acquisition"2010.	Total Hours: 45 Hrs Controllers and Industrial 2012 Batten G. L., "Programmable			
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## **POWER ELECTRONICS APPLIE POWER SYSTEMS LABORATO**

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nd multi n	nachine	models	•		
ng steady	state ana	alysis.			
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#### **Course Outcomes**

At the en	d of the cour	se, the student	will be al	ole to				
CO1:	Analyze the	e small signal st	tability of s	single machine and	l multi machine	models.	-	
CO2:	Analyze the	e effect of FAC	TS control	lers by performing	steady state an	alysis.		
CO3:	Analyze the	e concepts in di	fferent wir	nd energy conversi	on technologies	3.		
	(3/2/	1 indicates the	CO/P strength o	<b>O, PSO Mapping</b> f correlation) 3-Str	ong, 2-Medium	, 1-Weak		
COs	Pro	gramme Outcon	Outcomes (POs) and Programme Specific Outcomes (PSOs)					
-	PO1		PO2	PO3	PO4	PO5		
CO1	3		3	3	3	3		
CO2	3	3	3	3	3	3		
CO3	3		3	3	3	. 3		
			Course A	Assessment metho	ods			
		Di	rect			Indirect		
CIE test I	(20)	RTPS	(10)					
Quiz 1 (5) CIE test I Quiz 2 (5)	) I (20) )	Total C Semest	CIE: 60 ma ter End Ex	rks amination: 40 mar	ks	Course end survey		

## LIST OF EXPERIMENTS

- 1. Small-signal stability analysis of single machine-infinite bus system using classical machine model
- 2. Small-signal stability analysis of multi-machine configuration with classical machine model
- 3. Load flow analysis of two-bus system with STATCOM
- 4. Transient analysis of two-bus system with STATCOM
- 5. Available Transfer Capability calculation using an existing load flow program
- 6. Modeling and simulation of variable speed wind energy conversion system- DFIG
- 7. Modeling and simulation of variable speed wind energy conversion system- PMSG
- 8. Simulation of MOSFET, IGBT based Choppers
- 9. Simulation of IGBT based Single phase inverters

# 10. Simulation of single phase AC voltage controller

Theory:	Tutorial:		Practical:60 Hrs	Project:	Total Hours: 60 Hrs	
				9.2	aku	
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At the er	nd of the	course, th	e student v	vill be able t	0				15	•		
CO1:	Develo	p the PLC	c program fo	or the implen	nentation of logic	gates						
CO2:	Develo bottle E	p the PLC Bain& cyl	c program for inder actuat	or controlling	g the Pressure, Le ator control appli	vel an cation	d Flow	Parame	eters and	d also f	for	
CO3:	Design	and deve	lop a real tin	me industrial	application in au	itomat	ion don	nain.				
	(	(3/2/1 ind	icates the st	CO/PO, I rength of cor	<b>PSO Mapping</b> relation) 3-Stron	g, 2-M	ledium.	1-Weal	k			
COs		Program	me Outcome	s (POs) and P	rogramme Specifi	c Outc	omes (P	SOs)			}	
		PO1	PC	)2	PO3	P	04		PO5			
CO1		3	3		3	3			3			
CO2		3	3		3	3			3			
CO3		3	3		3	3			3			
			1	Course Asse	ssment methods							
Direct								Indirect				
CIE test I (10) – Laboratory Quiz 1 (5) CIE test II (10) – Laboratory			CIE III (10) – Project Record (10) Total CIE: 50 marks					Course end				
Quiz 2 (5	)		Semester SEE : Lal	End Examina poratory	tion: 50 marks	5			survey			
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- 1. Write ladder logic program for AND and OR gate.
- 2. Write ladder logic program for NAND and NOR gate.
- 3. Write ladder logic program for NOT and EX-OR gate.
- 4. Automate the level and flow control using PLC.
- 5. Conduct the temperature control using PLC.
- 6. Conduct the pressure and flow control using PLC.
- 7. Conduct the control of elevator using PLC.
- 8. Study the Bottle filling process using PLC.
- 9. Conduct the cylinder sequencing using simple pneumatic direct control valve.
- 10. Write ladder logic program for the traffic light controller using PLC.
- 11. Conduct the special I/O for speed control of DC motor using PLC.
- 12. Programming in HMI and SCADA.

Theory:	Tutorial:	Practical:60 Hrs	Project:30 Hrs	Total Hours: 90 Hrs	
			Dr.S. PADMA	M.E., Ph.L.	

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Sona College of Technology Salem-636 005. Tamil Nadu.

<b>P23</b> G	GE702		Stress N	Anagement by Yog	a	L	T	P	J	C
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Course Ou	utcomes			-			Sec. 1	Sin alardan		L.
At the end	d of the cour	se, the s	tudent wil	l be able to	. 11 1.		-			
CO1:	Develop ph	ysical a	nd mental f	lealth thus improving	social healt	h				
CO2:	Increase im	munity	power of th	e body and prevent	diseases					
CO3:	Accelerate	memory	power	idanaa and datamin	ntion					
CO4:	Improve sta	bility of	f with com	dence and determina	auon with a	wakana	d wied			
005:	improve sta	ionity of			work with a	wakciit	a wisu	JIII		
			U	ourse Assessment m	ethous					
			Direc					Indire	ct	1997
CIE test I (	(30)			Total CIE: 100 mark	S					
CIE test II	(30) I (40)			Semester End Exam	ination: NIL		Cou	rse end	survey	
nit 01:	1 (10)							6	Hours	3
Yoga-Intro Asana- Yo Regularizat	duction - As oga Exercise- tion of breathi	stanga Y and being techn	oga- 8 part enefits- Pra	s-Yam and Niyam etc nayam Yoga- Nadi s effects-Practice and k	c Do's and suthi, Practic apalapathy pr	Don'ts be and actice.	in life-B Spinal	Sclearar	of Yog ice Pra	a and actice-
nit 02:								6	Hours	5
Body relaxa Yoga- 2. Sa Init 03:	ation practice anthi Yoga-Pr	and its lactice-Ba	benefits- Ra	tice- Magarasa Yoga, ja Yoga- 1.Agna –expl physical and mental po	lanation and p wer.	oractice-	Activat	ion of P	ituitary	- Raja
Body relaxs Yoga- 2. Sa nit 03: Raja Yoga -practice- benefits	ation practice anthi Yoga-Pr a- 3. Sagasra Yogic exerci	and its l actice-Ba thara yo ise to im	ga –practic	tice- Magarasa Yoga, ja Yoga- 1.Agna –expl physical and mental po ce- Activation of dom sical and mental hea	lanation and p wer. mant brain c lth and pract	ells-Ka	Activati yakalpa	ion of P 6 -theory- cplanati	Hours - Kaya on-Pra	- Raja kalpa
Body relax: Yoga- 2. Sa Init 03: Raja Yoga -practice- benefits Init 04:	ation practice anthi Yoga-Pr a- 3. Sagasra Yogic exerci	and its l actice-Ba thara yo ise to im	ga –practic	tice- Magarasa Yoga, a Yoga- 1.Agna –expl physical and mental po ce- Activation of dom sical and mental hea	lanation and p wer. mant brain c lth and pract	ells-Ka	Activati yakalpa	ion of P 6 -theory- cplanati	Hours	- Raja kalpa
Body relaxs Yoga- 2. Sa nit 03: Raja Yoga -practice- penefits nit 04: Sun nam viruchasan Self- cont Yractice)-Y	ation practice anthi Yoga-Pr a- 3. Sagasra Yogic exerci askar- 12 na etc-Stress trol- Food a Yoga Free fro	and its l actice-Ba thara yo ise to im poses-e manage nd yoga om ANC	ga –practic prove physical prove physical	tice- Magarasa Yoga, ja Yoga- 1.Agna –explosively and mental po- ce- Activation of dom- sical and mental hear and practice-Yoga Yoga-Role of wome f self-destructive har alization of anger)&	a -Asana-P n and Yoga abits Avoid practice	ells-Ka ice-Asa admasa Equalit fault th	yakalpa mas –ex ma, va y, nonv hinking	ion of P ion of P -theory cplanation jrasana violence (thoug	Hours - Kaya on-Pra Hours , chakra , Hum ht ana	- Raja kalpa ctice- isana, anity, lysis-
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Department of Humanities & Languages, Sona College of Technology SALEM - 636 0002

Programme: M.E/M.Tech

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