

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY), PUNE

Faculty of Engineering And Technology M.Tech. Electrical Engineering New Syllabus

M.Tech Electrical Engineering (Power Systems) CBCS Pattern (2019)

STRUCTURE & EXAMINATION PATTERN

Semester I Subjects	Tea Schen Hrs.	ching ne (Hrs) /Week	Total Duration: 20 hrs/v Total Marks :500 Total Credits: 18 Examination Scheme (Marks) Scheme (Credits)						20 hrs/wee 00 8 ination 1eme edits)	k Total Credit s	
	L	Р	Theory	Unit Test	Attend ance	Tutorial/as signments	TW	Pract/ Oral	ТН	TW/PR /OR	
Research Methodology	04		60	20	10	10	-		04	-	04
FACTS and HVDC	04		60	20	10	10	-		04	-	04
Advanced Microcontroller & Its Applications	04	02	60	20	10	10	25	25	04	01	05
Power System Modeling	04	02	60	20	10	10	25	25	04	01	05
Total	16	04	240	80	40	40	50	50	16	02	18

Semester II	ester II Total Duration: 20 hrs/week Total Marks :500 Total Credits: 18									eek	
Subjects	Teac Scheme Hrs./V	hing e (Hrs) Week		Examination Scheme (Marks)					nation Scheme Examination Marks) Scheme (Credits)		
	L	Р	Theory	Unit Test	Attendan ce	Tutorial/ assignme nts	TW	Pract/ Oral	ТН	TW/PR/ OR	
Power Systems Dynamics	04		60	20	10	10			04	-	04
Digital Protection of Power System	04	02	60	20	10	10	25	25	04	01	05
PLC & SCADA	04	02	60	20	10	10	25	25	04	01	05
Elective - I	04		60	20	10	10			04		04
Total	16	04	240	80	40	40	50	50	16	02	18

Semester III Total Duration: 28 hrs/week Total Marks : 500 Total Credits: 40									s/week				
Subject	Teac Schem Hrs./	ching e (Hrs) Week	Examination Scheme Exa S		Examination Scheme		Examination Scheme Examination Scheme (Credits)						Total Credits
	L	Р	Theory	Unit Test	Attenda nce	Tutorial/ assignme nts	TW	Pract/ Oral	ТН	TW/PR /OR			
Power Quality Issues	04	02	60	20	10	10	25	25	04	01	05		
Elective –II	04	02	60	20	10	10	25	25	04	01	05		
Self-Study Paper-I	04		60	20	10	10	-	-	04	-	04		
Dissertation Stage –I	-	07	-	-			25	25		21	21		
Seminar	-	05	-	-			25	25	-	05	05		
Total	12	16	180	60	30	30	100	100	12	28	40		

Elective – I	Elective - II
a) Power Sector Restructuring & Deregulationb) Power system planning & reliability	a) Advanced Control systemb) Advanced Power Electronics & Drives

Semester IV Total Duration: 14 hrs/v Total Marks : 325 Total Credits: 34									rs/week		
Subject	Subject Teaching Examination Scheme Scheme (Hrs) Hrs./Week					Examination Scheme		Examination Scheme (Credits)		Total Credits	
	L	Р	Theory	Unit Test	Attendanc e	Tutorial /assignm ents	TW	Pract/ Oral	ТН	TW/P R/OR	
Self-Study Paper-II	04		60	20	10	10	-	-	04	-	04
Dissertation Stage –II	-	10	-	-		-	150	75		30	30
Total	04	10	60	20	10	10	150	75	04	30	34

List of Self Study paper I & II

Self Study Paper I	Self Study Paper II
Condition Monitoring of Electrical Equipments	Electrical Power Capacitors
Energy Storage Devices	Nano technology & its applications in Electrical
	Engineering
Digital Measurement Techniques	High voltage insulation system & design
Energy Conservation & Audit	Use of synchronized measurement techniques in
	power system
Solar PV & Wind energy systems	Distributed Generation
Demand response & demand side management	Smart Grid - Automation System for State
	Transmission Utility
Digital Signal Processing Applications in Power	Substation design
Systems	

		RESEARCH METHODOLOGY		
TEACHIN	NG SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTEI):
Theory: (04 Hours / Week	End Semester Examination: 60 Marks	04 Credits	
		Continuous Assessment: 40 Marks		
UNIT - I	Fundamentals			(08 Hours)
	Definition, Research	h Characteristics, Research Need, Objectives	and types of	
	research, Motivatio	n and objectives - Research methods vs M	lethodology,	
	Types of research -	- Descriptive vs. Analytical, Applied vs. F	fundamental,	
	Quantitative vs. Quantitative	alitative, Conceptual vs. Empirical		
UNIT - II	Formulation of resea	arch problem		(08 Hours)
	Research Formulati	ion – Defining and formulating the researc	h problem -	
	Selecting the proble	em - Necessity of defining the problem - In	nportance of	
	literature review in	defining a problem – Literature review –	Primary and	
	secondary sources -	- reviews, treatise, monographs-patents – wel	b as a source	
	– searching the web	- Critical literature review – Identifying gap	areas from	
	literature review -	Development of working hypothesis. Sur	nmarizing a	
	Technical Paper -su	mmary template, Online tools - Google, Cit	eSeer, ACM	
	Digital Library, I	EEE, The on-line Computer Science b	oibliography,	
	Searching patents			(0011)
UNII - III	Research design met	thods		(USHours)
	Research design, sa	mpling design and scaling techniques – Res	earch design	
	- Basic Principles-	Need of research design — Features of go	od design –	
	Important concepts	s relating to research design, basic p	rinciples of	
	experimental design	ns, implications of sample design, steps in sam	nple design,	
	criteria of selecting	g sampling procedure, characteristics of good	od sampling	
	design, different ty	pes of sample design. Scaling techniques: r	neasurement	
	scales, sources of	error, technique of developing measur	rement tool,	
	important scaling te	chniques, scale construction techniques.		
UNIT - IV	Statistical analysis			(08 Hours)
	Data Collection and	d analysis:- Observation and Collection of	primary and	
	secondary data - M	fethods of data collection, processing operation	ons, types of	
	analysis, statistics i	n research, measures of central tendency,	measures of	
	dispersion, measur	es of asymmetry, measures of relationsl	nips, simple	
	regression analysis,	multiple correlation and regression, partial co	orrelation.	
UNIT - V	Research Paper & T	hesis writing		(08 Hours)
	Reporting and thesi	s writing – Structure and components of scien	ntific reports	
	- Types of report -	Technical reports and thesis - Significance	– Different	
	steps in the prepara	tion – Layout, structure and Language of ty	pical reports	
	– Illustrations and	tables - Bibliography, referencing and foot	notes - Oral	
	presentation – Plann	ning – Preparation – Practice – Making presen	tation –	

	Use of visual aids - I	mportance of effective communication - Documentation	
	and presentation too	ls: LATEX. Types of technical papers - Journal papers.	
	Conference papers.	Survey papers. Poster papers. Review papers	
	Comparison. Struct	ure of a survey, conference and journal paper.	
	Organization and	flow of thesis/ Project report. Research proposal:	
	preparation budgeti	ng presentation funding agencies for engineering	
	research,	ng, presentation, randing ageneies for engineering	
UNIT -	Research ethics, IPH	R and publishing	(08 Hours)
VI			
	Ethics: ethical issues.		
	IPR: intellectual pro	perty rights and patent law, techniques of writing a	
	Patent, filing procee	dure, technology transfer, copy right, royalty, trade	
	related aspects of int	ellectual property rights Publishing: design of research	
	paper, citation and a	cknowledgement, plagiarism tools, reproducibility and	
	accountability.		
Text Book	s:		
1. Ko	othari, C.R., Research I	Methodology: Methods and Techniques. New Age Interna	ational
2. Ga	rg, B.L., Karadia, R.,	Agarwal, F. and Agarwal, U.K., An introduction to Resea	rch
Me	thodology, RBSA Pub	lishers	
3. Su	resh Sinha, Anil K Dh	iman, Research Methodology, ESS Publications, Volumes	2
4. Da	y R.A., How to Write	and Publish a Scientific Paper, Cambridge University Pre	ess
5. W	adehra, B.L. Law relat	ing to patents, Trade Marks, copyright designs and geogra	aphical
ind	ications. Universal Lav	w Publishing	
		-	
Reference	Books:		
1. Lo	uis Cohen, Lawrence	Manion and Keith Morrison, Research Methods in Educat	tion, 7th
Ed	lition, Cambridge Univ	versity Press, ISBN – 978-0415-58336-7	
2. A	nthony, M., Graziano,	A.M. and Raulin, M.L., Research Methods: A Process of	
Inc	quiry, Allyn and Bacor	1	
3. R	anjit Kumar, Research	Methodology: A Step by Step Guide for Beginners, 2nd	Edition,
AI	PH Publishing Corpora	tion	
4. Le	edy, P.D. and Ormrod	, J.E., Practical Research: Planning and Design, Prentice I	Hall
5. Fi	nk, A., Conducting Re	search Literature Reviews: From the Internet to Paper. Sa	ıge
Pu	blications		
6. Le	slie Lamport, ' Latex:	A document preparation system' Addison Wesley, Readin	ıg,
Ma	ssachusetts, second		
Syllabus for	or Unit Test:		
Unit Test -	1	UNIT – I, UNIT – II, UNIT - III	
Unit Test -	2	UNIT – IV, UNIT – V, UNIT - VI	

	FACTS & HVDC							
TEACHING	<u>S SCHEME:</u>	EXAMINATION SCHEME:	CREDITS	ED:				
Theory: 04	Hours / Week	End Semester Examination: 60 Marks	04 Credits					
		Continuous Assessment: 40 Marks						
UNIT - I	FACTS:			(08 Hours)				
	Conventional me reactors, Phase sh AC transmission converter structur topologies, Conv control issues	eries, Shunt ers, Flexible Static Power lk converter er converter						
UNIT - II	Shunt and Series	s Compensation:		(08 Hours)				
	Operation and co Capacitor, SVC, SVC, Power os resonance, TCSC TCSC, Static Syn							
UNIT - III	Unified Power F	low Controller:		[08 Hrs]				
	UPFC configurat Control scheme f Dynamic perforn studies in UPFC e							
UNIT - IV	General Backgro	ound of HVDC Transmission:		(08 Hours)				
	EHV AC versus HVDC link - Mo HVDC link, Equ phase six pulse an waveforms. Effe Control of DC vo	s HVDC Transmission, Different config onopolar, Bipolar, Back to Back, Power fl aation for HVDC power flow, Connection nd twelve pulse converter bridges, Voltage ct of delay angle, Extinction angle, Ove ltage	surations of low through ons of three and current erlap angle,					
UNIT - V	Multi Terminal	HVDC:		(08 Hours)				
	Bipolar HVDC te arrangements in I switching system. Sequence of switc interruption, Com HVDC circuit bre tapping, Reversal HVDC systems, C							
UNIT - VI	Protection and C	Control:		(08 Hours)				
	Faults and abnorn Pole-wise segrega reenergizing, Pro DC yards, Integra control, Block d	nal condition in bipolar, Two terminal HV ation, Protective zones, Clearing of DC lin tection of converters, Transformer, Conve ation of protection and controls, Hierarchic iagram, Schematic diagram, Current con	DC system, e faults and erter valves, cal levels of trol, Power					

	control, DC voltag	e control, Commutation channel, Master control,						
	Station control, Lea	ad station, Trail station, Pole control, Equidistant						
	firing control, Synch	ronous HVDC link, Asynchronous HVDC Link						
Text Books:	Text Books:							
1. E.Acha	, V.A.Agelidis, O.A	Anaya-lara and TJE MillerNewnes, Power Electron	ic control in					
Electr	rical Systems Oxford	L.						
2. N.G. Hi	ngorani and L.Gyug	i, Understanding FACTS- IEEE Press, New York.						
3. J. Arrila	ga, Y.H.Liu and N.F	R.Watson, Flexible Power Transmission- The HVDC	Options,					
John Wi	iley and sons Ltd., N	lew York.						
	· · · · · ·							
Reference Bo	oks:							
1. TJEN	Miller, "Reactive Pov	wer Control in Electric Systems", John Wiley						
2. Padiya	ar K R "FACTS Con	trollers in Power Transmission & Distribution", New	Age.					
3. R. Mc	han and R.K.Varma	a, "Thyristor-Based FACTS Controllersfor Electrical	Transmission					
System	Systems", IEEE Press.							
Syllabus for U	Unit Test:							
Unit Test -1	l	JNIT – I, UNIT – II, UNIT – III						
Unit Test -2	l	JNIT – IV, UNIT – V, UNIT – VI						

Advance Micro controllers and applications								
TEACHING	G SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:					
Theory: 04	Hours / Week	End Semester Examination: 60 Marks	04 Credits					
		Continuous Assessment: 40 Marks						
		TW&OR : 50 Marks	01 Credits					
UNIT - I	Introduction to	PIC 16F8XX family and development to	ols. CPU (08 Hours)					
	architecture and	instruction set. Harvard architecture and p	pipelining,					
	program memory	considerations, register file structure and a	addressing					
	modes, CPU regi	sters.	-					
UNIT - II	PIC peripherals		(08 Hours)					
	I/O ports, extern	al interrupts and timers, timer operation, A	DC, short					
	overview of sync	hronous serial port, serial peripheral interface	E I2C bus.					
UNIT - III	Learning MPL	AB (V 5.0 or above) Integrated dev	velopment (08 Hours)					
	environment fro	m Microchip (Assembler and simulator),	,Study of					
	applications like	motor control, temperature control, lamp dim	nmer, 4X4					
	matrix keyboard	and LCD interfacing etc.						
UNIT - IV	ARM & AVR	Processors : RISC, ARM design philosoph	hy, ARM (08 Hours)					
	fundamentals, if	istruction set, thumb instruction set, exc	ception &					
	interrupt nandling	g, efficient C programming, optimizing ARM	assembly					
	communication li	nks and design issues	nerracing,					
UNIT - V	Interfacing	nics and design issues.	unication (08 Hours)					
	synchronization	of processes tasks threads devices & t	numeration, (00 mours)					
	networks, hardw	are-software co-design embedded program	nming in					
	C/RT Linux	6 I I 6	0					
UNIT - VI	Real time operat	ing systems: Survey of software architectur	res- round (08 Hours)					
	robin, with inter	rupts, function queue scheduling, RTOS are	chitecture,					
	selecting an arcl	nitecture, task states, task and data semapl	hores and					
	shared data, mes	sage queues, mailboxes ,pipes, timer functior	ns, events,					
	memory manager	nent, interrupt routines in an RTOS environm	nent, basic					
	design using R	TOS, embedded software development too	ols, Micro					
	C/OS- II, VX wo	rks.						
D 6 -								
Reference B	ooks:	<i>«</i> , , , , , , , , , , , , , , , , , , ,						
1. Micr	cochip PIC family f	Viicrocontroller handbook						
2. Desi	gii witti PIC IIIICIO	austom architecture programming and de	II ASIA, LPE					
J. RAJK	on 2003	system –arenitecture, programming and de	sign , i with rublication,					
4 Davi	d Simon " An emb	edded software Primer" Pearson education	Asia					
5 Iona	than W. Valvan	Brooks Cole" Embedded Microcomp	iter systems-Real time					
inter	facing" Thomson I	Learning	ster systems rour time					
Syllabus for	Unit Test:							
Unit Test -1		UNIT – I, UNIT – II, UNIT – III						
Unit Test -2		UNIT – IV, UNIT – V, UNIT – VI						

		Power System Modeling				
TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALL	OTTED:		
Theory: 04	4Hours / Week	End Semester Examination: 60 Marks	04Credits			
	-	Continuous Assessment: 40 Marks				
-		PR & OR : 50 Marks	01 Credits			
UNIT – I	Modeling of Non-Elect	rical Parameters:		(08 Hours)		
	Different areas of po	wer system analysis, Need for mathematica	al modeling of			
	power system, Simpli	ied models of non-electrical components s	such as boiler,			
	steam & hydro turbine	governor system				
UNIT – II	Modeling of Transform	ners:		(08 Hours)		
	Transformer modeling	for two winding transformer, tap-changer,	phase shifting			
	transformer, three win	ding transformer and auto-transformer				
UNIT – III	Modeling of Transmiss	ion Line:		(08 Hours)		
	Modeling of transmiss	ion network, Transformation to Alpha-Bet	a components			
	using D-Q components	Steady state equations	-			
UNIT – IV	Synchronous Machine	Modeling:		(08 Hours)		
	Introduction, Park's T	ansformation, Flux Linkage Equation, Volta	age Equations,			
	Formulation of State-S	pace Equation, Current Formulation, Per Ur	nit Conversion,			
	Normalizing Voltage e	quations, Normalizing Torque Equations, To	rque & Power			
	Equivalent Circuit of Synchronous Machine					
UNIT – V	Excitation System Mod	eling :				
	Types of excitation syst	ems, Control and protective systems, Modelin	ng of	(08 Hours)		
	excitation systems (exc	itation system components and entire excitat	ion system,			
	Voltage Response Ratio	, Exciter voltage ratings				
UNIT – VI	Load Modeling:					
	Basic Load Modeling co	ncepts, Static load representation, Dynamic lo	bad	(08 Hours)		
	representation, Inducti	on motor (as load) modeling, synchronous mo	otor (as load)			
	modeling, acquisition c	f load model parameters				
Text Books	S:					
1. K. R. P	adiyar", Power System D	ynamics", B.S. Publications				
2. John J.	Granier & W.D. Stevens	on Jr., "Power System Analysis", 4" Edition, N	AcGraw Hill Inte	rnational		
Studer	nt Edition		1	nd To the		
3. Olle El	legard, "Electrical Energy	System Theory - An Introduction", TMH Publis	shing Company, 2	Edition		
4. Kundu	r, "Power System Dynam	ICS & Control", IEEE Press, New York				
Defense	Deelee					
Reference	BOOKS:					
1. An	aerson & Foud, "Power	system Control & Stability", Vol-I, IEEE Press, I	New York			
2. P.S	S.K. Murthy, " Power Syst	em Operation & Control				
Cullabora f	u linit Tost					
Syliabus fo						
Unit lest -:	1					
Unit lest -2	2					
Unit Test-3		UNIT –V, UNIT-VI				

	Power System Dynamics				
TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:		
Theory: 0	4 Hours / Week	End Semester Examination: 60 Marks	04 Credits		
	-	Continuous Assessment: 40 Marks			
		·			
UNIT - I	Classical Methods of P	ower System Dynamic Studies		(08 Hours)	
	Equality and inequality	constraints in power system operation, state tra	nsition		
	diagram, concept of sy	stem security and stability, classical model of syst	tem of one		
	machine connected to	infinite bus, Clark diagram for two machines series			
	reactance system, exte	nsion of Clark diagram to cover any reactance ne	etwork,		
	elementary model of o	verall power system		100.00	
UNIT - II	Small Signal Stability:			(08 Hours)	
	Small signal analysis, a	inalysis of synchronizing & damping torque, stat	te equation		
	for small signal model,	Simplified synchronous machine model, calculati	ion of initial		
	conditions, system sin	mulation, improved model of synchronous mac	chine, small		
	Large Signal Analysis			(08 Hours)	
	Elementary view of	transient stability Large signal analysis Ana	alvsis using	(00 110013)	
	numerical integration	methods (Modified Fuler's, Runge-Kutta), Sin	nulation of		
	power system dynami	c response. Analysis of unbalanced faults. Case	study of a		
	large system		,		
UNIT - IV	Power System Stabiliz	ers:		(08 Hours)	
	Basic concepts of cont	rol signals in power system stabilizers (PSS), Str	ructure and		
	tuning, Field implementation, PSS design and application, Future trends				
UNIT - V	Multi-machine system	:		(08 Hours)	
	Simplified model, Imp	roved model of the system for linear load, Inclus	sion of load		
	and SVC, Introduction	to analysis of large power system			
UNIT - VI	Voltage stability:			(08 Hours)	
	Definition, Factors affe	ecting voltage stability & collapse, Analysis & cor	mparison of		
	angle & voltage stabi	lity and voltage instability & collapse, Control	of voltage		
	instability, islanding	- necessity, methods, advantages and disc	advantages,		
	Implication on power s	ystem dynamic performance			
Text Book	<u>s</u> .				
1. An	derson &Foud, "Power system	Control & Stability". IEEE press. New York			
2. Oll	eElgerd, "Electrical Energy Sy	ystem Theory - An Introduction", TMH			
Reference	Books:				
1. K I	R Padiyar, "Power System Dy	namics", B S Publications			
2. Pra	bhaKundur, "Power system S	tability & control", TMH			
3. C.V	W.Taylor, "Power System Vol	tage Stability", TMH			
4. R.	A. Walling, "Distributed Gen	eration Islanding", N.W. Miller			
Syllabus fo	or Unit Test:				
Unit Test -	1	UNIT – I, UNIT – II, UNIT – III			
Unit Test -	2	UNIT – IV, UNIT – V, UNIT – VI			

Digital Protection of Power System					
TEACHING S	CHEME:	EXAMINATION SCHEME:	CREDITS ALL	OTTED:	
Theory: 04	Hours / Week	End Semester Examination: 60 Marks	04 Credits		
		Continuous Assessment: 40 Marks			
		TW & OR : 50 Marks	01 Credit		
UNIT – I	Introduction:			(08 Hours)	
	Need for Power system	protection, Digital Protection: State of Art	, Merits of		
	Microprocessor relaying s	cheme, Power System Components, Basic Pl	nilosophy of		
	Protection Scheme, Sectio	n of Protection Scheme, Circuit Breakers and R	elays, Types		
	and Applications. Architect	ure of Modern Digital Relay			
UNIT - II	Static Relays:			(08 Hours)	
	Introduction to Static Relay	y, Overcurrent Relay, Distance Relay, Protection	Schemes of		
	transmission lines, Switche	ed distance relay, Poly-phase relay, Relay as C	omparator -		
	Dual input Comparator, Re	elay characteristics by comparison of constants,	Multi-input		
	comparator, Pilot Relaying	Scheme			
UNIT - III	Elements of Digital Protec	tion:		(08 Hours)	
	Basic components of a digi	tal relay, Signal conditioning subsystem: Transd	ucers, Surge		
	protection circuits, Analog	filtering and analog multiplexers, Conversion	subsystems,		
	Sampling Theorem, Digital	filter signal aliasing error, Sample and hold ci	rcuit, Digital		
	multiplexing, Digital to an	alog conversion, Analog to digital conversion,	Digital relay		
	subsystem, Digital relay as	unit			
UNIT – IV	Digital Protection of Trans	mission Line:		(08 Hours)	
	Protection scheme of trans	smission line, Distance Relay, Travelling wave re	elays. Digital		
	protection scheme based on fundamental signal: hardware design, software design,				
	Digital protection of EHV/UHV transmission line based on travelling wave				
	phenomena, New relaying	scheme using amplitude comparison		(22.11.)	
UNIT – V	Digital Protection of Trans	former and Synchronous Generator:		(08 Hours)	
	Faults in Transformer, Sch	emes used for Transformer Protection, Digital P	rotection of		
	Transformer	nameter. Duetertien achement fan Comehaeren			
	Faults in Synchronous ge	nerator, Protection schemes for Synchronous	generator,		
	Digital Protection of Synch	ronous Generator		(00 110.000)	
ONII - VI	Artificial Intelligence in Po	wer System Protection:	tion	(08 Hours)	
	Introduction, An Expert Sys	stem (ES) for Protective Relay Settings: Introduct	tion,		
	eviction: Description, ES Ap	stion Problem Description El Approach Artific	Power		
	Network (ANN) in Phase Se	Alection: Introduction, Problem Description, Ma			
	of fault generated in high f	requency components ANN Approach	asurement		
		requercy components, Ann Approach			
Taut Da alua					
1 ext BOOKS:	ital Duatastian - Duatastiva	Deleving from Electre Mechanical to Micropyce		Circh 2 nd	
I. Dig	ion Reprint-2004 New Age	Relaying from Electro-Mechanical to Microproc	essor By L.P.	Singn. Z	
2 "Dia	ital Power System Protectio	n" By S.R. Bhide DHILearning Drivate Limited	New Delhi		
2. Ulg 2 "Ar+	ificial Intelligence Technique	as in Power Systems" By Keyin Warwick Author	r Ekwing & Dai	Δσσαηγγαί	
Duh	lication · Institution of Flect	rical Engineers London LIK		nggai wai,	
	ital Protection for Power sy	stem" hv A T Johns and S K. Salman. Datar Dara	rinus Itd Of	The Institute	
nf Fl	lectrical Engineers London	United Kindom.		me institute	
5. "Sof	t Computing Techniques ar	nd its Applications in Electrical Engineering" By C)r. Devendra (haturvadi.	
Text Books: 1. "Dig Edit 2. "Dig 3. "Art Pub 4. "Dig of E 5. "Sof	of fault generated in high f ital Protection – Protective ion, Reprint-2004, New Age ital Power System Protectio ificial Intelligence Technique lication : Institution of Elect ital Protection for Power sy lectrical Engineers, London, it Computing Techniques ar	requency components, ANN Approach Relaying from Electro-Mechanical to Microproc International Publisher, New-Dehli. In" By S.R. Bhide. PHI Learning Private Limited, es in Power Systems", By Kevin Warwick, Auther rical Engineers, London, UK. In Electrical Engineering (Section 2014) United Kindom.	essor" By L.P. New Delhi. r Ekwue & Raj grinus Ltd. Of ⁻ Dr. Devendra C	Singh. 2 nd Aggarwal, The Institute haturvadi,	

Publication: Springer	– Verlag Berlin Heidelburg.
Reference Books:	
 "Power System Prote Association. Publishe 	ction 4: Digital Protection and Signalling" edited by ETA Electricity Training d by Institute of Engineers, London, UK.
2. Digital Signal Proces Szafran, Andrzej Wisz	sing in Power System Protection and Control [®] By Waldemar Rebizant, Janus; niewski.
2. Digital Signal Proces Szafran, Andrzej Wisz	sing in Power System Protection and Control" By Waldemar Rebizant, Janus: zniewski.
Szafran, Andrzej Wisz	sing in Power System Protection and Control [®] By Waldemar Rebizant, Janus; niewski.
2. Digital Signal Proces Szafran, Andrzej Wisz Syllabus for Unit Test: Unit Test -1	sing in Power System Protection and Control [®] By Waldemar Rebizant, Janus: zniewski. UNIT – I, UNIT – II, UNIT - III

		PLC and SCADA		
TEACHING S	CHEME:	EXAMINATION SCHEME:	CREDITS ALL	OTTED:
Theory: 04 H	lours / Week	End Semester Examination: 60 Marks	04 Credits	
		Continuous Assessment: 40 Marks		
		Term Work: 50 Marks	01 Credits	
	1			
UNIT – I	Introduction to PLC			(08 Hours)
	Definition & History of Pl	LC, Overall PLC system, PLC Input and Out	put modules, CPU,	
	Interfaces, Power supplie	es, PLC advantages and disadvantages, Se	election criteria for	
	PLC, Architecture of Ind	duction to Sequence Control, Process Col	alay Laddor Logic	
	Hardware environment	duction to sequence control, rics and h	elay Laudel Logic,	
UNIT – II	PLC Programming			(08 Hours)
	Programming equipment	ts, Construction of PLC ladder diagram,	Basic components	(00 110415)
	and symbols in ladder	diagram, Ladder logic, Functional bloc	k, Structural text,	
	Instruction, trouble sho	oting, features, programming ON/OFF I	nputs to produce	
	ON/OFF outputs, Networ	king of Sensors, Actuators and Controllers	: The Fieldbus, The	
-	Fieldbus Communication	Protocol		
UNIT – III	PLC Applications			(08 Hours)
	Analog PLC operation,	PID control of continuous processes, si	mple closed loop	
	systems, closed loop system using Proportional, Integral & Derivative (PID), PLC			
	motor controller Variable	e speed (Variable Frequency) AC motor Dr		
UNIT – IV	SCADA			(08 Hours)
	Need of SCADA system,	Features, SCADA architecture – First g	eneration, Second	
	generation, Third genera	tion, HMI, MTU, RTU, IED's, 7 Layers of O	SI, Communication	
	requirements for SCADA	(communication protocols – DNP, IEC,	Ethernet, TCP/IP,	
	Modbus, UDP), Client – S	Server based communication concept, SCA	DA Benefits	
UNIT – V	SCADA in Power System	n		(08 Hours)
	Operation and control of	interconnected power system, Automatic	substation	
	State estimation SCADA	tion, Energy Management System (EMS), s	system security,	
LINIT – VI	Supervisory Manageme	nt		(08 Hours)
	Networked SCADA enviro	nment with implementation examples. Su	hstation	(00 110013)
	Automation and Equipme	ent condition monitoring using SCADA. Dis	tribution system	
	design mapping, trouble	call management, Customer level intellige	, nt automation	
	system, computer level m	nonitoring and control of equipments		
Text Books:				
1. Ters	on, "Power System Control	Technology", Prentice Hall		- 1
2. Gree	en, J. N, Wilson, R, "Conti cic 2007	rol and Automation of Electric Power Di	stribution Systems"	, Taylor and
Fran 3 Turn	us, 2007 Per M/ C "Epergy Manage	ment Handbook" 5 th Edition 2004		
2. Turn 4. Gary	Dunning "Introduction to	Programmable Logic Controllers" Thomse	on 2 nd Edition	
5, John	W. Webb. Ronald A. Reis	"Programmable Logic Controllers: Principle	es and Application"	5 th Edition
6. Stua	rt A Boyer, "SCADA supervi	sory control and data acquisition"		
	, ,	,		

Reference Books:					
1. Handschin, E. "Energy Manager	1. Handschin, E. "Energy Management Systems", Springer Verlag, 1990				
2. Gordan Clark, Deem Reynders,	"Practical Modem SCADA Protocols"				
Syllabus for Unit Test:					
Unit Test -1 UNIT – I, UNIT – II, UNIT – III					
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI				

(Elective – I) Power Sector Restructuring & Deregulation				
TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTI	ED:
Theory: 0	4 Hours / Week	End Semester Examination: 60 Marks	04 Credits	
		Continuous Assessment: 40 Marks		
UNIT - I	Power Sector in India			(08
	Introduction to various institutions in an Indian Power sector such as CEA, Planning Commissions, PGCIL, PFC, Ministry of Power, State and Central governments, REC, Load Dispatch Centers, Utilities and their roles. Critical issues / challenges before the Indian power sector, Electricity act 2003-Provision in the Generation, Transmission& Distribution Sector, Various national policies and guidelines under this act.			
				(0.0
UNIT - II	Fundamentals of Economics& Power Sector Regulation Fundamentals of economics applicable to Power Sector, Consumerbehavior, Supplier behavior, Market Equilibrium, Short- run & Long- run costs, Various costs of production- Total cost (TC), Average fixed cost (AFC), Average variable cost (AVC), Average cost (AC) and Marginal cost (MC), Relationship between short-run and long-run average costs, Perfectly competitive market, Concept of life cycle cost, Annual rate of return, methods of calculations of Internal Rate of Return(IRR) and Net Present Value(NPV) of project, Role of regulation and evolution of regulatory commission in India, Types and methods of economic regulation. Regulatory process in India		(08 Hours)	
	Power Tariff Different tariff principles Consumer tariff structure tariff, fixed and variable based penalties and incer of different tariff structur time to time. Effect tariff,Availability based ta	(marginal cost, cost to serve, average cost), es and considerations, different consumer cate charges, time of day, interruptible tariff, ar ntives etc., Subsidy and cross subsidy, life line t es for different load patterns. Government poli of renewable energy and captive power riff, Latest reformsand amendments	gories, telescopic ad different tariff ariff, Comparison cies in force from generation on	(08 Hours)
		a and market referm		(00
	Introduction to power set power industry, Understa competition, The market Different industry structu arrangements-Monopoly Retail competition mode Bilateral / forward contra TSO model,Reasons and world-The US, The UK, Management, Ancillary Set	ector restructuring, Reasons for restructuring anding the restructuring process-Entities involu- place mechanisms and Sector-wise major ch res and ownership models, Market models bas Model, Single buyer Model, Wholesale compe- el, Marketarchitecture, Timeline for various acts, The spot market, Models for trading arran objectives of deregulation of various power s The Nordic Pool and The developing cou	/ deregulation of ved, The levels of hanges required, ed on contractual etition model and energy markets, ngements, ISO or ystems acrossthe ntries.Congestion	(08 Hours)
UNIT - V	Electricity Markets Pricin	g and Non-price issues		(08
	Electricity price basics, M spot pricing and real time power flow Spot prices constrains and real spot supply and service, env	arket Clearing price (MCP), Zonal and locationa pricing, Dispatch based pricing, Power flows ar for real and reactive power. Unconstrained prices.Non price issues in electricity restruc ironmental and social considerations),Global	n MCPs, Dynamic, nd prices. Optimal real spot prices, turing (quality of experience with	Hours)

	electricity reforms in diffe	rent countries.	
UNIT - VI	Transmission Planning an	d Pricing	(08
	Transmission planning& o	peration in open access power systems, Introduction &	Hours)
	Principles of transmission	pricing. Differenttransmission pricingmethods. Transmission	
	cost allocation methods.	Marginal & Composite pricing Paradigms & their comparison.	
	Introduction to transmiss	ion loss allocation & various methods of loss allocation. Debated	
	issues in transmission pric	ring Congestion issues and management Ancillary Service	
	Management Forward ar	cillary service auction. Power nurchase agreements	
	management, rorward ar	initial y service duction. I ower parentase agreements.	
Reference	Books:		
1 Loile	i Lai 'Power System Restru	cturing & Deregulation, John Wiley & Sons Ltd	
2 "Know	v Your Power" A citizens Pr	imer On the Electricity Sector Prayas Energy Group Pune	
3 Sally F	Junt "Making Competition	Work in Electricity" 2002 John Wiley Inc	
4 Electri	ic Litility Planning and Regu	lation Edward Kahn American Council for Energy Efficient Econor	nv
5 D S K	irschen& G. Strhac 'Fundar	nentals of Power System Economics' John Wiley & Sons Itd	
6 Stever	n Stoft 'Power System Fcon	omic Designing markets for Electricity. Wiley-Inter Science	
7 M Sh	abidenour Hatim Vamin	7. 7 July 11 Market Operations in Electrical Power Systems For	ecasting
Sched	uling and Risk Managemen	t' Wiley Inter Science	seasting,
Jenea	uning and hisk management		
References	s:		
1. Regula	tion in infrastructure Servic	ces: Progress and the way forward - TERL 2001	
2. Mahar	ashtra Electricity Regulator	v Commission Regulations and Orders - www.mercindia.com	
3 Variou	s publications reports and	presentations by Prayas Energy Group Pune www.prayaspune.or	σ
4 Centra	l Electricity Regulatory Com	mission Regulations and Orders - www.cercind.org	4
5 Electric	rity Act 2003 and National I	Policies – www.nowermin.nic.in	
6 Marke	t Operations in Electric Poy	wer Systems Forecasting Scheduling and Risk Management –Mo	hammad
Shader	nur HatimYatim Zuvili		lannaa
7 Bhanu	Bhushan "ABC of ABT - A n	rimer on Availability Tariff" - www.cercind.org	
7. Dhana			
Website: N	IDTFI - Phase II-		
Website. I			
Syllabus fo	or Unit Test:		
Unit Test -:	1	UNIT – I, UNIT – II, UNIT – III	
Unit Test -2	2	UNIT – IV, UNIT – V, UNIT – VI	

(Elective – I)POWER SYSTEM PLANNING AND RELIABILITY				
TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTE	D:
Theory: 0	4 Hours / Week	End Semester Examination: 60 Marks	03 Credits	
Practical: ()2 Hours / Week	Continuous Assessment: 40 Marks		
		Term Work: 25 Marks	01 Credit	
	1			
UNIT - I	Unit 1: Load Forecas	ting :		(06
				Hours)
	Introduction, Facto	rs affecting Load Forecasting, Load Rese	arch, Load Growth	
	Characteristics, Class	ification of Load and Its Characteristics, Load	Forecasting Methods	
	-(I) Extrapolation (II) Co-Relation Techniques, Energy Forecasting, Peak Load			
	Forecasting, Reactive	e Load Forecasting, Non-Weather sensitive	e load Forecasting,	
	Ecrocosting Objective	Jau Forecasting, Annual Forecasting, Month	Ty Forecasting, Total	
	Medium Term Plann	ing Long Term Planning [10 brs]	Short Term Flamming,	
	Linit 2. Probability t			(06
				Hours)
	Introduction to prol	pability. Probability distributions : Random y	ariables, density and	noursy
	distribution functio	ns. Mathematical expectation. Binominal	distribution. Poisson	
	distribution. normal	distribution. exponential distribution. Weibull	distribution. Normal	
	Gaussian, Gamma ar	d Beta distribution. Correlation and regressio	n	
UNIT - III	Unit 3: Reliability			(06
				Hours)
	Reliability, Failure, Co	oncepts of Probability, Evaluation Techniques (i) Markov Process (ii)	
	Recursive Technique	, Stochastic Prediction of Frequency and Dura	ition of Long & Short	
	Interruption, Adequa	acy of Reliability, Reliability Cost.		
UNIT - IV	Unit 4: Generation P	lanning and Reliability :		
	Objectives & Factors	affecting Generation Planning, Generation So	urces, Integrated	
	Resource Planning, G	eneration System Model, Loss of Load (Calcula	ation and	
	Approaches), Outage	Rate, Capacity Expansion, Scheduled Outage,	Loss of Energy,	
	Evaluation Methods.	Interconnected System, Factors affecting inte	rconnection under	
	Emergency Assistance	e.		
UNIT - V	Unit 5: Transmission	Planning and Reliability		(06
	Tana ang ing ing Diang in	en and Daliability a later dusting. Objectives of T		Hours)
	I ransmission Plannir	ig and Reliability: Introduction, Objectives of I	ransmission	
	Composite System P	econinguration, system and Load Point marces,	Data required for	
	Unit 6: Distribution	Planning and Poliability		(06
				Hours)
	Radial Networks –	Introduction Network Reconfiguration Ev	aluation Techniques	110013)
	Interruption Indices.	Effects of Lateral Distribution Protection, Eff	fects of Disconnects.	
	Effects of Protectio	n Failure. Effects of Transferring Loads. Di	stribution Reliability	
	Indices. Parallel & N	Aeshed Networks -Introduction, Basic Evalua	tion Techniques, Bus	
	Bar Failure, Schedule	d Maintenance, Temporary and Transient Fail	ure, Weather Effects,	
	Breaker Failure.	· · ·	· · · · · ·	

Text Books:					
1.	Roy Billinton& Ronald	N. Allan, Reliability Evaluation of Power System - Springer Publication.			
2.	R.L. SullivanPower Syst	em Planning -, Tata McGraw Hill Publishing Company Ltd.			
3.	Miler& Freund's, Proba	bility and Statistic for Engineers, Pearson Education, Richard Johnson.			
Reference	Books:				
1.	X. Wang & J.R. McDona	X. Wang & J.R. McDonald, Modern Power System Planning –, McGraw Hill Book Company			
2.	T. Gönen, Electrical Power Distribution Engineering - McGraw Hill Book Company				
3.	B.R. Gupta Generation of Electrical Energy –, S. Chand Publications				
4.	A.S. Pabla, Electrical Power Distribution Tata McGraw Hill Publishing Company Ltd.				
5.	5. T.W.Berrie, Electricity Economics & Planning –, Peter Peregrinus Ltd., London				
Syllabus fo	Syllabus for Unit Test:				
Unit Test -:	1	UNIT – I, UNIT – II, UNIT - III			
Unit Test -2	2	UNIT – IV, UNIT – V, UNIT - VI			

Power Quality Issues

TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTE	<u>D:</u>
Theory: 0	4 Hours / Week	End Semester Examination: 60 Marks	04 Credits	
		Continuous Assessment: 40 Marks		
UNIT - I	Voltage sag; swells a	and interruptions		[8Hrs]
	Introduction; import IEEE std. 1159. Sour interruptions; Estim protection; solutions starting sags; evalua	ance of power quality; terms and definitions of p ces & Effects of Power Quality Problems; Sourc nation of voltage sag performance; Fundam s at end user level; utility systems and fault cle tion of the economics of different alternatives.	oower quality as per es of sag; swell and ental principles of earing issues; motor	
	Transiant Over Val			[0].]***]
	Transient Over- Voltages Sources of transient over voltages; capacitor switching; lightening; Ferro resonances and other switching transients; Principles of over voltage protections; devices of over voltage protections; Utility capacitor switching transients; Utility system lightening protection; managing Ferro resonance; switching transients problems with loads; computer tools for transient analysis.			[8Hrs]
	Eundomontals of U	rmonics and its Analysis		
	Introduction; the Mechanism of Harmonic Generation; Definitions and Standards: Factors Influencing the Development of Standards, Existing Harmonic Standards, General Harmonic Indices. Introduction to Harmonic Analysis; Fourier Series and Coefficients; Simplifications Resulting from Waveform Symmetry; Complex Form of the Fourier Series; Convolution of Harmonic Phasors; The Fourier Transform; Sampled Time Functions; Discrete Fourier Transform (DFT); The Nyquist Frequency and Aliasing; Fast Fourier Transform (FFT); Window Functions: Efficiency of FFT Algorithms: Alternative Transforms.			
UNIT - IV	Harmonic Sources a Harmonic Sources : Machine Harmonics Three-Phase Curren Thyristors-Controlled Harmonic Distortion Machines; Effect of I System Protection; Communications.	nd Distortions Introduction; Transformer Magnetization Non ; Distortion Caused by Arcing Devices; Single- nt-Source Conversion; Three-Phase Voltage-S d Reactors. n : Introduction; Resonances; Effects of Harr Harmonics on Static Power Plant; Harmonic Inter Effect of Harmonics on Consumer Equipment	linearities; Rotating Phase Rectification; Source Conversion; monics on Rotating ference with Power ; Interference with	[8Hrs]
	Computation Acces	ment and Hormonic Flimination		[011]
	Harmonic Computation, Asses Harmonic Computation Submarine Cables; L the Models; Harmonic Eliminatio Performance Calcula	ion : Introduction; Direct Harmonic Analysis; De es from Field Tests; Transmission Line Models oad Models; Computer Implementation; Examp n : Introduction; Filter Design Criteria; Network I tions; Tuned Filters; Damped Filters; Conventior	rivation of Network ; Underground and les of Application of mpedance for nal Filter	נסחנאן

	Configurations; Band-P	Configurations; Band-Pass Filtering for Twelve-Pulse Converters; Distribution System		
	Filter Planning; Filter Co	omponent Properties; D.C. Side Filters; Active Filter		
UNIT - VI Power quality monitor		ing; Assessment & Mitigation	[8Hrs]	
Need and approacher requirements; Initial s quality monitors; mon monitoring; Transient r		es followed in power quality monitoring; objectives and ite survey; Power quality Instrumentation; Selection of power itoring location and period; Selection of transducers; Harmonic nonitoring; event recording and flicker monitoring.		
	Power Quality assess waveform distortion; waveform distortion co observability analysis; Mitigation techniques a	ment; Power quality indices and standards for assessment; voltage and current unbalances; Power assessment under onditions. Power quality state estimation; State variable model; capabilities of harmonic state estimation; Test systems; at different environments.		
Reference	es:			
1. U	nderstanding power qual	lity problems; voltage sag and interruptions - M. H. J. Bollen IEE	E press;	
20	000; series on power engi	neering.		
2. "I	POWER SYSTEM HARMON	NICS", Second Edition By Jos Arrillaga and Neville R. Watson; Jon	n wiley	
	nd Publication, 2003 ISBN	: U-47U-85129-5.		
3. El	ectrical power system qu	Jality - Pogel C. Dugan; Mark F. McGrangnan; Surya santoso; H. Graw Hill Pub	wayne	
4 P	ower system quality asses	sment - L Arrillaga: M.R. Watson: S. Chan: John Wiley and sons		
5 F	lectric nower quality - G 1	Hevdt		
6 P	ower system harmonics:	Computer modeling and analysis- Enriques Acha: Manuel Madrig	al· Iohn	
v. 1	viley and sons ltd.		ai, soini	
7. P	ower System Harmonics –	J. Arrillaga & N. Watson		
8. IF	, FFF std 519-1992/ IFFF s	td 1159 IFFF recommended practices and requirements for ha	monics	
C(ontrol in electrical powers	system.	mornes	
9 F	CBC Code 2007 (Editi	on 2008) published by Bureau of Energy Efficiency. New	/ Delhi	
B	ureau of Energy Effic	iency Publications Bating System: TERI DURI ICATIONS		
	Dureau of Energy Efficiency Publications Rating System; TERI PUBLICATIONS GRIHA			
K	ating system; LEEDS P	UDIICALIOIIS		
Syllabus (for Unit Tost:			
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Unit Test	-2	$\frac{1}{1} = \frac{1}{1} = \frac{1}$		
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(Elective – II) Advanced Control System				
TEACHING	G SCHEME:	EXAMINATION SCHEME:	CREDITS AL	LOTTED:
Theory: 04	Hours / Week	End Semester Examination: 60 Marks	03 Credits	
		Continuous Assessment: 40 Marks		
	1			
UNIT - I	- I PID Control:			(08 Hours)
	Review of c	lassical and modern control concepts: Pl	ID control and	
	tuning approa	aches, Selection of Variables for Control,	PID Controller	
	Tuning for D	ynamic Performance - Determining Tunin	g Constants for	
	Good Contro	l Performance, Ziegler-Nichols method, (Correlations for	
	Controller tu	stants, Fine-Tuning the Controller Tun	ing Constants,	
	feedback	ing based on stability – Dead beat and st	tuning, Rate	
UNIT - II	State Variab	le Analysis.		(08 Hours)
	Control Syste	m Analysis Using State Variable Methods	Conversion of	(00 110015)
	transfer funct	ion to phase variable and canonical variable	le model Eigen	
	value and	eigen vector. Kalman's test and Gilb	ert's Test for	
	controllability	and observability analysis and design of co	ontrol system in	
	state space, Pole placement, State observer, Design of control system			
	with Luenber	ger observer		
UNIT - III	Nonlinear and Robust Control:			(08 Hours)
	Nonlinear Sy	stems and Equilibrium Points, Concept	s of Stability,	
	Describing f	unction analysis, Phase plane analysis,	Linearization,	
	Feedback I	inearization, input-output linearization	n, Input-State	
	Concept of r	obust control Description and categoriza	tion of system	
	uncertainties,	System and signal norms, Small gain the	eorem, Robust	
	stability, Desi	gn of robust control, Introduction to $H-\infty$ co	ontrol.	
UNIT - IV	Digital Cont	rol:		(08 Hours)
	Structure of	the Digital Control System, ADC, DA	AC, Effects of	
	Sampling of	continuous time signals, Quantization, Sa	mple and hold,	
	Reconstructio	n of signal, Sampling Theorem, Aliasin	ng, Elementary	
	discrete-time	signais, Impulse response, Linear conve	olution and its	
	properties, Z	and partial fraction difference equation St	talisionn using	
	in z- plane wi	th Jury's stability criteria	autry analysis	
	The second second			(00 11
UNIT - V	Frequency A	nalysis:		(08 Hours)

	Frequency response of first order and second order systems, Polar plot, Bode plot, Bode plot from Sweep Frequency Response Analysis (SFRA) of transformer and its conclusion, Phase and group delays, Ideal filters and their pole zero locations, Zero phase and linear phase transfer functions Exponential representation of Fourier series and Fourier transform of continuous time signals, The Fourier series for discrete-Time periodic		
	signals (only concept), The Fourier transform of discrete-time a periodic signals (only concept), Discrete Fourier Transform, Properties: Periodicity, Linearity, Symmetry properties, Circular convolution, Linear convolution using circular convolution, Fast Fourier Transform: Padix 2 DIT and DIE algorithms		
UNIT - VI	Optimal Control	-	(08 hours)
	Parameter optimization and optimal control problems, Hamiltonian formulation of optimal control problem, Hamilton-Jacoby equation, Linear regulator problem, Quadratic performance criterion, Numerical solution of Matrix Riccati equation, Pontryagin's minimum principle, Application to optimal control of discrete and continuous systems (quadratic performance index, analysis and design of finite and infinite time), Linear Quadratic Regulators, Introduction to Linear Quadratic Gaussian approach		
Text Books:	<u> </u>		• • • • •
1. 'Mod	1. 'Modern Control Engineering'- Katsuhiko Ogata, Prentice Hall India, 5th edition 2010.		
2. 'Non-	linear Systems', by	v Hassan Khalil, Prentice Hall.	
3. Digita	al Control – Ogata ,	Prentice Hall India	
Keterence B	Reference Books:		
I. Digta	I Control- B.C.Kuc		11 D-11' 1'
2. Digital Control and State Variable Methods' by M. Gopal, Tata-McGraw-Hill Publishing Company Limited			
3. Optin	3. Optimal Control: Linear Quadratic Methods' Brian D. O. Anderson, John Barratt Moore.		
Dove	r Publications, 2007	7	
Syllabus for	Unit Test:		
Unit Test -1		UNIT – I, UNIT – II, UNIT – III	
Unit Test -2 UNIT – IV, UNIT – V, UNIT – VI			

(Elective – II) ADVANCED POWER ELECTRONICS AND DRIVES				
TEACHING	TEACHING SCHEME: EXAMINATION SCHEME: CREDITS AI		CREDITS ALL	OTTED:
Theory: 0	Theory: 04 Hours / WeekEnd Semester Examination: 60 Marks04 Credits			
Practical: 02 Hours / Week Continuous Assessment: 40 Marks				
		Term Work: 25 Marks	01 Credit	
UNIT - I	Converters:			(08 Hours)
	Voltage Source Conver	ters		
	Review of 3-ph-full wave bridge converter, operation and harmonics, 3 level			
	voltage source conver	ters. PWM converter. Generalized techniqu	e of harmonic	
	elimination and voltage	e control. Advanced modulation techniques	(space vector	
	Current source conver	ters		
	(i) Matrix Converter	3x3 matrix converter principle of working	mathematical	
	treatment, comparisor	of matrix converter with multipulse converte	r	
	(ii) Self and Line com	mutated current source converter: Basic con	ncepts of CSC,	
	converters with self co	mmutating devices		
UNIT - II	Multilevel Inverters:			(08 Hours)
	Multilevel concept, T	ypes of multilevel Inverters, diode clamp	ed multilevel	
	inverter, flying-capaci	tors multilevel inverters, cascaded multil	evel inverter,	
	switching device curr	ents, D.C. link capacitor voltage balancing	g, features of	
	multilevel inverters, co	omparison of multilevel inverters. Application	s of multilevel	
	Inverter: Reactive power compensation Back to back intertie system			(08 Hours)
	Single phase and 3 phase converter drives. Four quadrant Chopper drives, closed			(00 110013)
	loop control of DC motor, Permanent magnet DC motor drives, DC Servo drives,			
	applications			
UNIT - IV	/ Induction Motor Drives: (08 Hours)			
	3 phase induction motor control, stator voltage control/rotor voltage control,			. ,
	voltage and frequency control, current control, closed loop control of 3-phase			
	induction motor. Soft starters, comparison of variable frequency drives. Speed			
	control by static slip power recovery, induction motor servo drives, applications.			
UNIT - V	Synchronous Motor D	ives:		(08 Hours)
	Voltage and frequency	control, closed loop control of synchronous m	otors.	
	Synchronous motor se	vo drive with sinusoidal waveform, synchrono	ous motor	
	servodrive with trapezoidal waveform. Load commutated invertor drives, speed			
	control of synchronous motors by cyclo-convertors, applications			
UNIT - VI	Akagi's p-q theory (08 H			(08 Hours)
	Conventional concepts of active and reactive power in single phase and three			· · ·
	phase circuits-Equation of power with sinusoidal voltage source and non-linear			
	loads -αβo transformat	ion of three phase four wire system-Akagi's ir	stantaneous	
	power (pq) theory-rela	tionship between Akagi's components and co	nventional	
	active and reactive pov	ver application of pg theory to reactive and ha	rmonic power	
	compensation in simpl	e circuits.		
	1 · · · · · · · · · · · · · · · · · ·	-		
	1			

Text Books:			
1. Bimal K Bose, Modern power e	Bimal K Bose, Modern power electronics and AC drives, Pearson education asia		
2. G. K. Dubey, Fundamentals of	Electrical Drives CRC press 2002		
3. VedamSubrahmanyam Electric	Drives: Concepts & Appl Tata McGraw-Hill		
4. Power electronics convertors	, applications and design, Ned Mohan, Tore M Undeland, William P		
Robbins, Wiley India Pvt. Ltd.,	2009		
5 E. Acha, Miller & Others, Pow	er Electronic Control in Electrical Systems (Newnes, Oxford publication) -		
first Edition			
6 M. H. Rashid Power Electronics	s, Prentice Hall of India Pvt. Ltd. New Delhi, (3rd Edition)		
7. R Krishnan, Electric motor drive	es, modeling, analysis and control, PHI learning Pvt. ltd. 2001		
8. S.K. Pillai, A first course in elect	trical drives, Newage international publishers. 2010		
Reference Books and Papers:			
1. E. H. Watanube, R.M. Stephen and Maurico Ardes "New Concepts of instantaneous active and			
reactive powers in Electric	reactive powers in Electrical systems with Generic loads" (IEEE transaction on Power Delivery Vol.8,		
no.2 April 1993, PP-697-70	no.2 April 1993, PP-697-703		
2. L. Benchaita, S. Sadaate an	2. L. Benchaita, S. Sadaate and A. Salemnia – "A comparison of voltage source and current source shunt		
Active filter by simulation	Active filter by simulation and Experimentation" (IEEE Transaction on Power Systems, Vol 14, No.2,		
May 99, PP 642-647	May 99, PP 642-647		
3. H. Akagi, E.H. Watanabe and M. Aredes "Instantaneous Power Theory and Applications to Power			
Conditioning, IEEE Press, N	ew York		
Syllabus for Unit Test:			
Unit Test -1	UNIT – I, UNIT – II, UNIT - III		
Unit Test -2 UNIT – IV, UNIT – V, UNIT - VI			

Following Elective and self study subjects are added in 2015 course

Addition of Elective Courses

1. M.Tech Electrical Sem II Elective I

a. Electric & Hybrid Vehicles b. Application Softwares in Electrical Engineering

2. M.Tech Electrical Sem III Elective II

a. Energy Management and Auditing b. Simulation & Programming

Addition of Self Study Subject :

3. M.Tech Electrical Sem III Self Study I

a. Electrical codes and standards

4. M.Tech Electrical Sem IV Self Study II

b. Industrial Safety practices

Elective-I: Electric & Hybrid Vehicles				
TEACHING SCHEME:		EXAMINATION SCHEME:	CREDITS ALLOTTED:	
Theory: 04 Hours / Week		End Semester Examination: 60 Marks	Theory: 04	
Practical:	02 Hours / Week	Internal Assessment: 40 Marks	Practical: 01	
Course Pre-	requisites:			
The Students	should have prior k	knowledge of Electrical Engineering		
Course Obje	ectives:			
	1. Explain th	ne basics of electric and hybrid electric	vehicles, their architecture	
	2. Discuss the	ne design and component sizing and the	e power electronics devices used in elec	tric and
	hybrid ele	ectric vehicles.		
	3. Analyse v	various electric drives suitable for elec	tric and hybrid electric vehicles.	
	4. To help th	ne students for understanding the conc	ept of powertrain sizing and energy man	agement
	system			
	5. Understar	nding of different energy storage techn	ologies and power electronics system us	sed for
	electric ar	nd hybrid electric vehicles		
Course Outc	comes: After lea	arning this course students will be able	e to	
1	Identify Electric Vehicle (EVs)-issues, trends, systems.			
2	Classify Electric Vehicle(EVs)			
3	Explain Electric Vehicle Architecture			
4	Explain Hybrid Vehicle Architecture			
5	Describe Power train components of Electric and Hybrid Vehicles			
6 Apply energy management strategies to Electric Vehicle systems				
UNIT - I	Electric venicie-issues, trends, systems (08 Hours)			
	Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV			
	Engine EV System	m: EV Configuration: Fixed & variable	a georing single & multiple motor	
	Engine. EV System: EV Configuration: Fixed & variable gearing, single & multiple motor			
	narameters	urives LV Tarameters. Weight, siz	e, loree, energy & performance	
UNIT - II	Classification of EVs		(08 Hours)	
	Classification of	EVs in reference of: Propulsion dev	ices. Energy sources. Energy carriers.	(00 110 015)
	Pure Electric Veh	nicles (PEV), Hybrid Electric Vehicle	es (HEV) and Plug-in Hybrid Electric	
	Vehicles (PHEV). Configurations: Battery Electric Vehicles (BEV). Fuel cell electric			
	vehicles (FCEVs), Conventional full HEV.			
UNIT - III	Hybrid Vehicle Architecture (08			(08 Hours)
	Introduction - Concept of Hybrid Electric Drive trains - Architectures of Hybrid Electric Drive			
	trains - Series and Parallel Hybrid Electric Drive trains - Coupling Modes - Operating Modes			
	– Hybridization factor – Plug-in hybrid electric vehicles (PHEVs) – Performance			
	characteristics			(0.0.77
UNIT -IV	Electric Vehicle	Architecture		(08 Hours)
	Introduction- Con	figurations - Traction Motor Characte	ristics - Tractive Effort and	
	Transmission Requirement – Power Flow Control in Electric Drive train – Positioning of			
	Motors - Vehicle	Performance - Tractive Effort in Norn	hai Driving - Energy Consumption –	
LINIT V	Single and Multi Motor drives NUT: V Deriver train components of Habrid and Floatsia Valiable (00 H)			(08 H ours)
	Traction Motor T	unes Configuration and Control D	Motor Brushless DC Motor DLDC	
L		ypes – configuration and control - De	\sim motor- prusingss pC motor – pLDC	

		Motor Control - Switched Reluctance Motor to Power electronic components – Electronic	r – AC Induction – Motor Drives and Introduction c Control Unit of Motors – Various Control Modes	
		– Drive system Efficiency		
UNIT	- VI	Power train Energy Management System	n :	(08 Hours)
		Introduction to energy management strateg	ies - classification of energy management	
		strategies - rule based and optimization stra	ategies - real-time working of energy	
		management system in HEV - model-based	d design and simulation process - Implementation	
		issues of energy management strategies		
Term	Work:	The term work shall consist of minimum eig	ht experiments	
1.	Study	y of BLDC / PMSM/AC Induction electric ver	hicle motor	
2.	Study	y of various batteries used for Electric Vehicle	e(Industry visit to manufacturing company)	
3.	Study	y of basic controllers for Electric Vehicle		
4.	Study	y of electric vehicle lighting system		
5.	Study	y of electric vehicle charger (Demonstration a	t EV company/MSEB charging point)	
6.	Mode	eling & simulation of electric vehicle/hybrid e	electric vehicle with professional software	
7.	Study	y of performance of electric vehicle using pro-	fessional software	
8.	Dem	onstration of electric vehicle manufacturing (l	Industry visit to manufacturing company)	
Projec	t Base	d Learning		
Case st	tudies,	Demonstration of syllabus topic by using pro	fessional software/hardware models	
Refere	Reference Books:			
1.	1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc.,			
	2017.			
2.	 Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017 			
3.	Elect	ric and Hybrid Vehicles Power Sources, M	odels, Sustainability, Infrastructure and the Marke	et Gianfranco
	Pisto	ia Consultant, Rome, Italy, Elsevier Publication	ons, 2017.	
4.	Mode	ern Electric, Hybrid Electric, and Fuel Cell	Vehicles, MehrdadEhsaniYiminGao Stefano Longo	o Kambiz M.
	Ebrahimi, Taylor & Francis Group, LLC, 2018.			
5.	Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.			
6.	Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.			
7.	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010.			
8.	8. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles:			
0	Fundamentals, Theory and Design, CRC Press, 2009.			
9.	Jame	s Larminie, John Lowry, Electric Vehicle Tec	chnology Explained, Wiley, 2003	
Syllab	us for	Unit Test:		
	UnitTest-1 UNIT-I, UNIT-II, UNIT-III			
	Uni	tTest-2	UNIT–IV, UNIT–V, UNIT-VI	

	Elective-I: Application Softwares in Electrical Engineering			
TEACHIN	G SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTT	ED:
Theory: 04	Hours / Week	End Semester Examination: 60 Marks	Theory: 04	
Practical: 02	tical: 02 Hours / Week Internal Assessment: 40 Marks Practical : 01			
Course Pre	e-requisites:			
The Studen	ts should have knowledge of			
	Basic Electric Machines, Ma	gnetic Theory, Introduction to Electrical Powe	er system, Structure of	Electrical
	power system, Sources of El	ectrical Energy, Elements of Power system	•	
Course Ob	iectives:			
	• Students will get well fa	amiliar with importance of electrical design, di	fferent design techniqu	les and
	application of tools for	electrical design and analysis.	0 1	
Course Ou	teomos: Students will be able	to		
1.	Relate the basic knowledge	of electrical system with electrical design		
2.	Understand the importance	of software tool and explore its GUI		
3.	Apply the knowledge of too	blbar for understanding the design concept		
4	Identify various electrical a	pplications as per software tools		
5	Discuss the methods of software simulation in electrical engineering			
6	Apply the knowledge for de	esign and analysis of electrical machines		
UNIT - I Introduction to Electrical Design: 08 Hours				08 Hours
Introduction to Electrical System for Electrical Design and analysis, Application of Electrical				
Design, Purpose of Electrical Design, Basic Design philosophy, Importance of Results from				
	design tools, design optimization, Standard Rules for Electrical Design.			
UNIT - II	Introduction to ETAP Soft	tware:		08 Hours
Introduction to ETAP software, Importance of ETAP for System design, History of ETAP, Key				
	features & Benefits of ETAP	, Codes & Standards, Working with ETAP sof	ftware- Starting ETAP	
	software, Creating a new pr	oject, Changing the Project standard, File Ma	anagement, Exploring	
UNIT - III	Toolbar and Library for F	ТАР		08 Hours
	Toolbar Description - Project	Toolbar Theme Toolbar System Toolbar M	ode Toolbar, Base &	00 110015
	Revision Toolbar Inserting ('ircuit Elements- Library for Circuit Elements	System Elements and	
	Components, Element Classif	ication - AC Elements, DC Elements, AC-DC	Elements,	
	Instrumentation Elements, C	omponent Editor	,	
UNIT - IV	Introduction to ANSYS M	axwell software:		08 Hours
	Introduction to ANSYS Max	well software and general applications, Appli	ications of software in	
	electrical engineering, Maxwell solvers-electric and magnetic solution, GUI, RMXprt tool,			
	Introduction to 2D simulation, Introduction to 3D simulation.			
UNIT - V	ANSYS Maxwell software	simulation:		08 Hours
	Finite element method, Selec	tion of Geometry and solver types, Defining an	nalysis plane,	
	selection of solver, model uni	ts, Exploiting magnetic/excitation symmetry is	n model, Assigning	
	material properties,	ndary conditions. Model verification		
	Electric Machine simulation			08 Hours
VI				50 110015

Need for machine simulation, Applications of A	NYSY Maxwell software for machine		
simulation, Design and analysis of any one elect	ric machine using RMXprt tool, Maxwell 2D		
simulation, Maxwell			
[3D simulation, Discussion on simulations result	<u>s.</u>		
Term Work:			
The term work shall consist of record of minimum eight exp	periments in ETAP and ANSYS with flowchart and results from		
below list.			
1. Prepare the list of tools used for Electrical Design and	nd Analysis		
2. Prepare a new project and change the project standa	rd using ETAP software		
3. Study of system toolbars in details with its application	on in ETAP software		
4. Study of system elements and components in ETAP	' software		
5. Study of Library for ETAP software and its applicat	ions		
6. Study the components editor and its working in ETA	AP software		
7. Design and analysis of any one conventional electric	cal motor using RMXprt tool.		
8. Study of 2D model for any one conventional electric	cal motor using ANSYS Maxwell software.		
9. Study of 3D model for any one conventional electric	cal motor using ANSYS Maxwell software		
10. Design and analysis of any one special purpose mach	hine using RMXprt tool.		
11. Study of 2D model for any one special purpose mach	hine using ANSYS Maxwell software.		
12. Study of 3D model for any one special purpose mach	12. Study of 3D model for any one special purpose machine using ANSYS Maxwell software		
Project based Learning:			
1. Obtain and prepare Single Line Diagram from any r	eal time project in ETAP software without any errors.		
2. Develop a substation SLD of any voltage level by giving suitable input parameters			
3. Generate reports through above analysis and give presentation on the results obtained.			
4. Designing Induction motor/BLDC motor/ Switched Reluctance motor as per specifications using RMXprt.			
5. 2D model of assigned machine through ANSYS Ma	ixwell software.		
6. Develop an article based on any content related to E	TAP software get it published in conference/technical journal		
etc.			
7. Develop an article based on any content related to A	NSYS software get it published in conference/technical journa		
etc.	etc.		
Text Books:	A start History I still MATLAD as 1 FTAD? OD C Dave		
1. Hemchandra Madnusudan Shertukde, "Power System Taylor and Francis Group	s Analysis illustrated with MATLAB and ETAP", CRC Press,		
2. Vivek Ravindran, Prajith Kumar, Sumit Tomar, "Mod	leling Simulation and Optimization of a Power System		
Network: A case study using ETAP software", LAP	2. vives Ravindian, Frajun Rumar, Summ Fomar, Woodenig, Simulation and Optimization of a Fower System Network: A case study using ETAP software", LAP Lambert Academic Publishing		
3. John E.Matsson, "An introduction to ANSYS Fluent 2	3. John E.Matsson, "An introduction to ANSYS Fluent 2021". SDC Publications.		
4. Huei-Huang Lee, "Finite Element Simulations with A	NSYS Workbench 2021 Theory, applications and case		
studies ", SDC Publication.			
Reference Books:			
1. T.Stolarski, Y.Nakasone, S.Yoshimoto "Engineering a	inalysis with ANSYS software", BH Publication.		
2. Saeed Moaveni, "Finite Element Analysis Theory and	application with ANSYS", Third edition, Pearson publicatior		
3. Dr.Marius Rosu, Dr.Ping Zhou, Dr.Dingsheng Lin, "N	3. Dr.Marius Rosu, Dr.Ping Zhou, Dr.Dingsheng Lin, "Multiphysics Simulation by Design for Electrical Machines.		
Power electronics and Drives", IEEE Press Wiley.	- · · · · · · ·		
Syllabus for Unit Test:			
UnitTest-1	UNIT–I, UNIT–II, UNIT-III		
UnitTest-2	UNIT–IV, UNIT–V, UNIT-VI		

Elective-II: Energy Management and Auditing				
TEACHING SCHEME:		EXAMINATION SCHEME:	CREDITS ALLOTT	ED:
Theory: 04 Hours/Week		End Semester Examination: 60 Marks	Theory : - 04	
		Continuous Assessment: 40 Marks	Total : - 04	
Course Pre-	requisites:			
The students	should have knowledge of			
1.	Various energy conversion process			
2.	Measurements and instrum	entation for electrical & non-electrical para	neters	
Course Obje	ctives:			
	This course introduces kr	nowledge about different energy sources	and the economics behi	nd it. It also
	explores energy various co	nservation techniques and methods of audit	ing. It also explores the	knowledge of
	financial aspects of energy	conservation & auditing. The course is desi	gned to learn different me	ethods.
Course Oute	amage Students will be able	to.		
	Identify the energy scenario	0 a st national and international level along w	th the energy conservation	n act
1.	It is the chergy seenary			m act.
2.	Understand the rolls and re	sponsibilities of energy manager and variou	s analysis techniques.	
3.		The Energy Audit and maximizing system entr	ciency	
4	Get the Knowledge of financial aspects related to energy conservation.			
5	Understand the various techniques of Energy Efficiency in Electrical Utilities.			
6	Understand the various tech	hniques of Energy Efficiency in Thermal Sy	stems	
UNIT - I Energy Scenario (08 Hours)				
	Energy sources-Primary an	d Secondary, Commercial and Non-comme	rcial, Energy scenario in	, , , , , , , , , , , , , , , , , , ,
	India and Global scenario	o, Energy Security, Energy and GDP, Er	nergy Intensity, Energy	
	conservation and its importance, Energy Conservation Act 2001 and related policies, Role of			
	Non- conventional and renewable energy.		(08 Hours)	
0111 - 11	Definition and Objective	s of Energy management Energy man	agement strategy Key	(00 110015)
	elements Responsibilities and duties of Energy Manager Energy efficiency Programs Energy			
	Monitoring System, Imp	ortance of SCADA, Analysis techniques	s, Cumulative sum of	
	differences (CUSUM)			
UNIT - III	Energy Audit			(08 Hours)
	Definition, need of energy	y Audit, Types of Energy Audit, maximiz	ing system efficiency,	
	instruments and metering	thermography. SMART metering	nution, Energy Audit	
UNIT - IV	Financial Analysis and M	anagement		(08 Hours)
	Investment need, financial	analysis techniques, Calculation of Simple	Pay-back period, return	(00 110415)
	on investment, cash flows, risk and sensitivity analysis, Time value of money, Net Present			
	value, Breakeven analysis, Cost optimization, Cost and Price of Energy services, Cost of			
	Energy generated through Distributed Generation			
UNIT - V	Energy Efficiency in Elec		1 1 1	(08 Hours)
	Electrical billing, power fa	ctor management, distribution and transform	er losses, losses due to	
	tariff in DSM and in Fu	nomes, Demand Side Management, Dema heroy management TOU tariff Power for	and-Response, Role of actor tariff Integrated	
	Resource Planning and H	Energy Management Energy conservation	in Lighting systems.	
	HVAC, Electric Motors, Pump and Pumping systems.			
UNIT - VI	Energy Efficiency in The	rmal Systems		(08 Hours)

Fuels and combustion, properties of Fuel principles of combustion, combustion of o systems, Furnaces, Insulation and Refractor	Oil, coal and gas, storage and handling of fuels, il, coal, gas. Energy efficiency in Boilers, Steam s.	
Text Books:		
1. Guide books for National Certification Examination fo (available online)	or Energy Manager / Energy Auditors Book-1, General Aspects	
2. Guide books for National Certification Examination for	or Energy Manager / Energy 55 Auditors Book-2, Thermal	
Utilities (available online)		
3. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)		
4. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-4, (available online)		
Reference Books:		
1. S. C. Tripathy, "Utilization of Electrical Energy", Tata Mc Graw HillEnergy Technology - S. Rao, Dr. B B Panelkar		
- Khanna Publication		
2. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)		
Syllabus for Unit Test:		
Unit Test -1	UNIT – I, UNIT – II, UNIT - III	
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI	

Elective-II: Simulation And Programming					
TEACHING	G SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:		
Theory: 04 Hours/Week		End Semester Examination: 60 Marks	Theory : - 04		
	Continuous Assessment: 40 Marks Total : - 04				
Course Pre-	requisites:				
The Students	should have knowle	dge of			
1.	Students should have	ve knowledge of Fundamentals of Elec	trical Engineering, basic mathematics	and basic	
	computer operation	l			
Course Obj	ectives:		1		
	The course introduc	ces fundamental concepts of simulation	and programming for problem solvir	ıg	
			_		
Course Out	comes: After lea	rning this course students will be ab	le to		
1	Describe the concept of simulation				
2	Identity and apply knowledge of software simulation				
3	Describe and Analyze Programming Techniques using application software's.				
	Describe fundamental concepts of MATLAD Simulifik Apply knowledge MATLAB Simulifik in Electric Applications				
6	Elaborate the score	pe and applications of PCB design	cations		
UNIT – I	UNIT - I Introduction to Simulation: 08 Hours			08 Hours	
	What is simulation: 00 Hours				
	Modeling basics,	computer simulation (Popularity as	nd advantages, different kinds of		
	simulation), How	simulation gets done (by hand, p	rogramming in general languages,		
	simulation language	es, high level simulators, Uses of simu	lations (past, present, future).		
	Fundamentals of s	simulation:	aning maning theory machanistic		
	simulation) Pieces	s of simulation model(entities attril	sutes variables resources queues		
	statistical accumula	ators, events, simulation clock, startin	g and stopping). Event driven hand		
	simulation.				
	Event and process oriented simulation Randomness in simulation. Simulation with spread				
	sheets, conducting	simulation studies.	1		
UNIT - II	Software Tools and Simulation: 08 Hours			08 Hours	
	Types of Analysis:				
	Bias point, Time domain, AC Sweep, DC Sweep, Parametric, Monte Carlo, Noise analysis.				
	Schematic Design:				
	Introduction, Descr	ription of P-Spice, Types of analysis,	Description of simulation software		
	tools (like OrCAD	/ PROTEL / Proteus / Microcap) S	ources output variables format of		
	circuit and output files drawing the schematic Design rule Check (DRC) Netlist details				
UNIT -III	Introduction to MATLAB programming: 08 Hours			08 Hours	

Introduction, starting and ending a MATLAB session, Fundamentals of MATLAB			
programming (MATLAB variables, arrays, matrices, matlab operators- arithmetic, relational,			
logical, MATLAB graphics(plots, subplots, other types of plots), benchmarking and looping			
functions(branching functions, looping functions), miscellaneous functions(string function,			
input/output function), examples on above topics, advantages of MATLAB, limitations of			
MATLAB, various matlab commands & their explanation. Introduction to GUI.			
UNIT -IV MATLAB Simulink Basics:	08 Hours		
Introduction, Introduction to simulink, starting simulink, simple examples on starting a			
simulink, solving differential equations in simulink, Commonly used blocks, application block			
sets (power			
system toolbox), user defined functions, Simulink modeling.			
UNIT - V MATLAB Basic Electrical Engineering Applications:	08 Hours		
Basic electrical engineering applications(introduction, elementary definitions, basic			
waveforms, average value -RMS value -peak value, ohms law, Kirchhoff's laws, independent			
and dependent Dc sources, series and parallel circuits, resonance phenomenon, network			
theorems, apparent power- active power-reactive power, three phase source and load simulation,			
transformers. Application related to Wind and Solar.			
UNIT -VI PCB Design and its Applications:	08 Hours		
Simulation of following circuits: half wave & full wave rectifier, Zener shunt regulator,			
transistorized RC coupled amplifier, clipper and clamper. Introduction to PCB design.			
<u>Term Work:</u> The term work shall consist of record of minimum eight experiments and not limited to			
List of experiments:			
1. Schematic drawing & component symbol creation			
2. Filerarchical schematic drawing 2. Simulation and analysis (bios point analysis time domain AC suscen DC suscen perspective) of DLC(Cimousit		
5. Simulation and analysis (bias point analysis, time domain, AC sweep, DC sweep, parametric) of RLC (Circuit.		
4. Experiments based on FCB design which would include component placement, setting design rules, aut	to routing		
5 Experiments based on poise analysis and Monte-carlo analysis			
6 To simulate simple calculator that performs basic tasks such as addition subtraction multiplication and d	livision with		
special operations like computing xy and x!			
7. To accept the number and Compute a) square root of number, b) Square of number, c) Cube of number	d) check for		
prime,	,		
d) factorial of number e) prime factors			
8. To accept two numbers from user and compute smallest divisor and Greatest Common Divisor of these	two numbers.		
9. To accept a number from user and print digits of number in a reverse order.			
10. To input binary number from user and convert it into decimal number.			
11. Experiment on unit 3: Listing of some common MATLAB commands and executing with examples			
12. Experiment on unit 4 : Basic simulation projects 13. Experiment on unit 5: Solving network theorems using MATLAP			
Project based learning:			
1) Project based on Network Theorems in MATLAB			
2) Design of Regulated Power supply in Proteus			
3) Design of Electronic circuitry for household applications in Proteus			
4) Design of Household applications on PCB			
5) Design of Electrical based applications in MATLAB			
Text book:			
1. M. H. Rashid 'Introduction to P-spice using OrCAD for circuits and Electronics' –Pearson Education			
Reference Books:			

User manuals of PROTEL, PROTEUS, OrCAD, Microcap. 1. 2. W.C. Bosshart 'Printed Circuit Boards-Design & Technology'-Tata McGraw-Hill Publication. 3. R. G. Dromey, "How to Solve it by Computer", Pearson Education India; 1st edition, ISBN10: 8131705625, ISBN-13: 978-8131705629 Maureen Spankle, "Problem Solving and Programming Concepts", Pearson; 9th edition. ISBN-10: 9780132492645. ISBN-13: 978-0132492645 Romano Fabrizio, "Learning Python", Packt Publishing Limited, ISBN: 9781783551712, 1783551712 4. 5. Paul Barry, "Head First Python- A Brain Friendly Guide", SPD O'Reilly, 2nd Edition, ISBN:978-93-5213-482-3 6. Martin C. Brown, "Python: The Complete Reference", McGraw Hill Education, ISBN-10: 9789387572942, ISBN-13: 978-9387572942, ASIN: 9387572943 7. Jeeva Jose, P. Sojan Lal, "Introduction to Computing & Problem Solving with Python", Khanna Computer Book Store; First edition, ISBN-10: 9789382609810, ISBN-13: 978-9382609810 Simulation with Arena by W.David Kelton, randall P. Sadowski, nancy B. Swets(Mc Graw Hill international 8. edition) 9. MATLAB and SIMULINK for engineers by Agam Kumar Tyagi (Oxford University Press). 10. MATLAB and its Applications in Engineering by Raj Kumar Bansal, Ashok Kumar Goel, Manoj Kumar Sharma(Pearson India Education Services Pvt Ltd.) 11. Introduction to MATLAB programming toolbox and sumulink by Jaydeep Chakravorthy (University Press India Private Limited) **Assignments:**

Assignments should be able to verify course outcome and skills of group work, communication skills. One assignment on each unit (total 6 assignments).

Syllabus for Unit Test:

Unit Test -1	UNIT – I, UNIT – II, UNIT - III	
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI	

Self study-I: Electrical Codes & Standards										
TEACHING	SCHEME:	EXAMINATION SCHEME:	CREDITS ALLOTTED:							
Theory: 04 H	Iours/Week	End Semester Examination: 60 Marks	Credits : 04							
	Continuous Assessment: 40 Marks									
Course Pre-	requisites:									
The Students	should have prior kno	wledge of								
	Standard values need	ed for better working of electrical power	systems							
Course Obj	ectives:									
	Understand the Basic	s of Electrical Codes & Standards for ele	ectrical power systems							
Course Out	comes: After learn	ing this course students will be able to								
1	Understand the Basi	cs of Electrical Codes & Standards								
2	Understand the reco	mmended standards for Transformers, Ea	arthing & hazardous areas							
3	Understand the Elec	trical Codes & Standards for Lighting &	z Side flashes							
4	Understand the Elec	trical Codes & Standards for Illumination	on, Lift and escalators.							
5	Understand the Elec	trical Codes & Standards for Power district	ribution, conductors, cables							
0	distribution network	urical Codes & Standards for Electrical I	installation & nardware material u	sed in						
	distribution network	.5								
UNIT – I	INTRODUCTION	to Electrical Codes & Standards		(08 Hours)						
	Basics of Electrica	Codes & Standards, Standard values,	International system of units,							
	electrical units & the	ir equivalents, , Summary of Indian Elect	tricity rules, degree of protection							
	for electrical equipm	ent, Insulating materials								
UNIT - II	Transformers:			(08 Hours)						
	Recommended sizes	of cables on secondary side (for 11kv.0	0.433 transformers manufactured							
	as per IS:2026-1977).Dieelctric strength of transformer oil :	as per IS:1866-1978. Testing of							
	Farthing.	55 1/1.								
	Extracts of IS·3043-I	Electrical shocks & fire hazards IS:5216-	Dos & Donts							
	Hazardous areas:									
	Electrical Installation	ns in Hazardous areas (abstract from M	National Electric code-1985 and							
	STEC 7 recommendation	ations)								
UNIT -III	Lighting & Side flag	shes		(08 Hours)						
	Protection of build	ngs & Allied structures against lightin	g:							
	Protection of buildin	gs & Allied structures against lighting (E	Extracts from IS:2309 and STEC							
	7 recommendations)	. standard clearances of electrical lines a	as per BS:162-1961 and BS:159-							
	1957									
	Lighting:									
	component parts for	lighting protection system minimum di	imensions of component parts of							
	lighting protective su	stem recommendation as per IS.2309-10	989 and STEC for buildings							
	Side flashes:	steni, recommendation as per 15.2507-17	or and other for buildings.							
1	Introduction Recom	mendation as per IS·2309-1989 and STF	C							

UNIT	-IV Illumination, Lift and escalators.	(08 Hours)
	Illumination:	
	Introduction, Recommended values of illumination for different parts of domestic dwelling,	
	glare index for commercial building, hospitals, hotels, assembly halls, cienemas, art galleries,	
	sports buildings, industrial buildings, recommendation for mounting heights of luminaries.	
	Illumination of roads & electrical installations (extracts from national electric code).	
	Lift and escalators:	
	Introduction, Bureau of standards on lifts and escalators.	
UNIT	- V Power distribution, conductors, cables,	(08 Hours)
	Power distribution:	
	Tubular steel poles for overhead power lines (extracts from IS;2713 - Part I to III – 1980.	
	Conductors:	
	Technical specifications as per IS:7098(1)-1988, IS:398(Part IV) 1994.	
	Cables:	
	Heavy duty-insulated power cables manufactured as per IS:692-1973, Household cables as	
	per IS:694-1990, Household cables as per BS:2004-1961	
UNIT	-VI Electrical Installation & hardware material used in distribution networks	(08 Hours)
	Electrical Installation:	
	Design of electrical power installation as per IEC 364 standards.	
	Hardware material used in distribution networks:	
	Dimensions, normal weights etc for steel tubes(specidfications as per IS:1239(partI)-1979 &	
	speicifications BS:1387-19670, Tolerance on diameter of black enameled MS conduit pipes	
	as per IS:9537(PartII)1981	
Town	Works	
The for	work:	
	Desding understanding and sharking meetically Electrical Codes & Standards, for Transforman at I	Iniversity
1.	compus/industrial organizations	Juversity
2	Panding understanding and checking practically Electrical Codes & Standards, for Farthing location	e in
2.	University computed industrial organizations	5 111
3	Reading understanding and checking practically Electrical Codes & Standards for Protection of bui	ldings &
5.	Allied structures against lighting in University campus/industrial organizations	unigs a
4	Reading understanding and checking practically Electrical Codes & Standards for Illumination facility	ities in
	University campus/industrial organizations	
5.	Reading, understanding and checking practically Electrical Codes & Standards for Lifts in University	tv
	campus/industrial organizations.	
6.	Reading, understanding and checking practically Electrical Codes & Standards for Power distribution	n,
	conductors, cables in University campus/industrial organizations.	,
7.	Reading, understanding and checking practically Electrical Codes & Standards for Electrical Installa	tion &
	hardware material used in distribution networks in University campus/industrial organizations.	
8.	Reading, understanding and checking practically Electrical Codes & Standards for Hazardous areas	if any in
	University campus/industrial organizations.	
T (D	•	
1 ext B	00KS: Corti Rememurthy, Handbook of Electrical Rewar Distribution, University press	
1.	Second edition	
Refere	nce Books:	
1	Frederic P Hartwell National Electrical Code 2020 Handbook Mc graw hill 30th edition	
2	Alonzo Robert I. Electrical Codes. Standards. Recommended Practices and	
2.	Regulations , William Andrew Publishing, English-Hardcover	
<u> </u>		14

3.	https://www.bis.gov.in/, Bureau of Indian Sta	https://www.bis.gov.in/, Bureau of Indian Standards (BIS) Catalogues, Year Of							
	Publication: 2013 & 2023								
4.	National Electric code 2011 & 2016, Governm	nent of India							
	(https://law.resource.org/pub/in/bis/S05/is.sp	p.30.2011.pdf)							
5.	Guide For Using National Building Code Of I	ndia 2016, Bureau Of							
	Indian Standards (https://cpwd.gov.in/Publica	ation/Booklet-Guide-for-Using-							
	NBC-2016.pdf)								
6.	The Indian Electricity Rules, 1956								
	(https://www.dgms.net/IErules1956.pdf)								
7.	NESC Handbook (sixth edition) - National Ele	ectrical Safety Code Handbook, IEEE,							
	(https://ieeexplore.ieee.org/servlet/opac?punur	mber=4670086), 2007							
Unit Tes	st:								
Unit Test	t -1	UNIT – I, UNIT – II, UNIT - III							
Unit Test	t -2	UNIT – IV, UNIT – V, UNIT - VI							

Self study-II: Industrial Safety Practices										
TEACHING	G SCHEME:	EXAMINATION SCHEME:	CREDITS:							
Theory: 04 H	Iours/Week	End Semester Examination: 60 Marks	Credits : 04							
Continuous Assessment: 40 Marks										
Course Pre-requisites:										
Students should have basic knowledge of safety practices										
Course Obj	ectives:									
1. To n	nake students aware about the	hazards while working in industry and res	pond appropriately in an	emergency.						
2. To h	elp prevent workplace injurie	s, illnesses and fatalities.								
3. To r	educe and remove existing da	ngers to improve working conditions.								
Course Out	comes:									
Students are	expected to:									
1	To understand importan	ce of safety								
2	To understand process s	afety management								
3	To evaluate safety in ha	zardous area								
4	To apply the knowledge	e of Industrial safety engineering								
5	To review of IE rules ar	nd acts and their significance								
6	To analyse case studies	on Industrial Safety Practices								
		Topics covered								
UNIT - I	Importance of Safety:			(08 Hours)						
	Health and environment. He	ealth safety and environmental policy, fund	lamentals of safety,							
	classification of accidents, l	Managements responsibility, objectives of a	safety management,							
	National safety council, Em	ployees state insurance act 1948, approach	es to prevent accidents,							
	principles of safety manage	ment, safety organization, safety auditing,	maintenance of safety,							
	Industrial accidents and pre-	formance, industrial noise and noise contro	l, Industrial Psychology,							
UNIT - II	Process safety management	nt:		(08 Hours)						
	Process safety management	legal aspects of safety, safety with respect	t to plant and	(00 110013)						
	machinery, the explosive ac	t 1884, Petroleum act 1934, personal prote	ctive equipment,							
	classification of hazards, pr	otection of respiratory system, work permit	t system, hazards in							
	refineries and process plant	s, safety in process plants, pollution in som	e typical process							
	industry. Safe working prac	tices, housekeeping, safe working environi	nent, safety device and							
	tools, precaution in use of la	adders, safety instruction during crane oper	ation, safety instruction							
	for welding, burning and cu	tting and gas welding equipment, electrical	l safety, case studies,							
	safety in use of electricity, e	electric shock								
	phenomena, occurrence of e	electric shock, medical analysis of electric s	shock and its effect,							
LINIT III	Safety in begandous area	plants, installation of Earthing system.								
UNII - III	Safety in industrial zones	classification of industrial Enclosures for a	ases and vanors							
	Mechanical Chemical Env	ironmental and Radiation bazards. Machin	ases and vapors. e guards and safety							
devices slings load limits lifting tackles and lifting equipment hydrostatic test Chemical										
	hazards, industrial toxicolog	y, toxic chemicals and its harmful effects	on humans, factors							
	influencing the effect of tox	ic materials. Units of concentration control	ol measure.							
	environmental hazards, dev	ices for measuring radiation, safety analysi	s and risk analysis, risk							
	management, First aid, Safe	ety galaxies and galaxies								
	measures to avoid occupation	onal diseases.								

UNIT -IV	Industrial Safety Engineering:		(08 Hours)							
	Industrial Lighting : Purpose of lighting,	Uses of good illumination, recommended optimum	`							
	standards of illumination, Design of light	ing installation, Standards for lighting and colour.								
	Vibration and Noise : Activities related to	vibrations, its impact on human health, abatement								
	Sources, effects of noise on man, Measur	ement and evaluation of noise, Silencers, Practical								
	aspects of control of noise.									
	Safety at various Industries: Agro-Industri	ry, Sugar Industry, Textile Industry etc.								
UNIT-V	Review of IE rules and acts and their si	gnificance:	(08 Hours)							
	Objective and scope –ground clearances and section clearances – standards on electrical									
	safety - safe limits of current, voltage –Rules regarding first aid and fire fighting facility.									
	The Electricity Act, 2003.									
UNIT-VI	Case studies on Industrial Safety Pract	ices:	(08 Hours)							
	Case studies in various industries like: Processing industry, Hazardeous material industry,									
	Engineering applications industry etc									
Practicals:										
List of Prac	tical's to be performed in the laboratory:									
1. Dem	onstration and training of how to use breath	ning apparatus,								
2. Dem	onstration and training of Emergency evacu	uation drill,								
3. Trai	n students how to rescue employees using e	mergency rescue equipments inside confined space.								
4. With	the help of gas detector train students chec	k the level of oxygen and other, Gases in industries,								
5. Trai	ning of using of windo meter to measure sp	eed level of wind,								
6. Trai	n students use noise level meter and find ou	t different level of noise of different equipments and t	each them							
how	tobe safe,									
7. Trai	n students how to use personal protective e	quipment,								
8. First	And training and demonstration.									
1 Study of L	a learning: Ioma And Industrial Safaty Using Fire And	Cas Detection System hit/system								
2 Industrial	Ion Safety project (IIOT). Industrial Interne	ot of Things using Arduino & FSP8266								
3 Study of A	nti-Collision Light · L GKT017 Simple Cir.	cuit Project								
4 Study of F	irst Aid Kits & Construction Safety									
5 Study of P	ersonal Protective Equipment (PPF) Kit for	industry								
6 Study of F	lectrical Safety Kit for industry	industry								
7. Case studi	es on – Learning industrial Safety through f	ïlms/Videos								
8. Case studi	es on – Learning industrial Safety through p	posters/charts								
9. Case studi	es on – Learning industrial Safety through r	periodicals, research publications								
10. Conducti	ng electric safety audit of any institute/Engi	neering college								
11. Conducti	ng power quality audit of any institute/Engi	neering college								
12. Auto pow	ver supply control from 4 different sources									
13. Over Vol	tage/Under Voltage Electrical Appliance Pr	rotector								
14. ATM Ma	chine Gate Security System									
15. Do-it-you	Irself intelligent camera	abt any animanta marfammad for a the shares 11 (
Drote: The te	rin work shall be the record of minimum ef	gni experiments performed from the above list.								
Project Dase	eu learning: Student snall demonstrate min	mum one concept based on synabus topic.								
Keterence B	OOKS:									
1. Indu First	strial satety management By: L.M. Deshmu	ikh Publishers: Tata McGraw Hill ,New Delhi Year: 2	2006 Edition:							
2. Indu Publ	strial safety health and environment Manag ishers Year: 2008 Edition: Second	ement system By: R.K. Jain & Sunil S. Rao Publisher	rs: Khanna							
Unit Test:										
Unit Test -1		UNIT – I, UNIT – II, UNIT - III								
Unit Test -?		UNIT – IV. UNIT – V. UNIT - VI								

Unit Test -1	UNIT – I, UNIT – II, UNIT - III
Unit Test -2	UNIT – IV, UNIT – V, UNIT - VI



BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY), PUNE

Faculty of Engineering And Technology M.Tech. Electrical Engineering Old Syllabus



BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY) Pune.

Faculty of Engineering & Technology Programme: M. Tech. (Electrical) (2015 Course) Course Structure & Syllabus (Choice based credit systems-2015) M. Tech (Electrical) Semester I to IV

1

Vision of the Institute

To be World Class Institute for Social Transformation through Dynamic Education

Mission of the Institute

- To provide quality technical education with advanced equipments, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

Vision of the Department:

To develop electrical engineers with professional skills to suit global needs.

Mission of the Department:

- To provide quality education through blend of core and interdisciplinary courses with industry-institute interaction.
- To provide an environment conducive to develop and implement new ideas in engineering and technology.
- To practice and promote interpersonal and leadership skills to work with commitment for social responsibilities

Program Specific Objectives (PSOs)

- **PSO 1:** Able to apply fundamental knowledge of Electrical Engineering to identify, formulate and investigate real time problems of electrical sector and allied fields.
- **PSO 2:** Analyze, design and integrate Electrical systems using modern tools and techniques in electrical sector and create passion for life-long learning and research in advanced fields.

Program Outcomes (POs)

After completing the electrical engineering programme the students will be able to:

- 1. Apply knowledge of mathematics, basic science and engineering fundamentals to solve complex problems in electrical engineering.
- 2. Identify problem in electrical systems based on available data and interpret the results.
- 3. Design electrical systems that meet specified needs with safety considerations.
- 4. Design and conduct experiments, analyze and interpret data.
- 5. Use modern electrical engineering softwares and tools.

- 6. Create awareness of electrical engineering solutions for social benefit considering current and upcoming tools / technologies.
- 7. Understand the impact of engineering solutions in a global, economic, environmental context.
- 8. Demonstrate ethics and professional abilities.
- 9. Work effectively as an individual and as a member in a diverse team.
- 10. Communicate effectively in both written and verbal form.
- 11. Demonstrate knowledge and understanding of engineering and management principles for execution of projects.
- 12. Recognize the need and ability to learn technological changes.

Programme Educational Objectives (PEOs)

The M. Tech Electrical Engineering Programme is preparing the graduates:

- **PEO 1:** To develop professional skills in students to provide solution to problems in electrical and allied fields.
- **PEO 2:** To develop students with conducive learning attitude for lifelong learning.
- **PEO3:** To demonstrate behavioral skills and ethics.

Proposed Structure of M. Tech Electrical Engineering (Power Systems) CBCS Pattern (2015-16)

SemesterI Subjects	Tea	ching			Examina	tionScheme		TotalDu TotalN TotalO	uration:20 Marks:500 Credits:18 Exam) hrs/week) } iination	Total
	Schen Hrs.	ne(Hrs) /Week			(M	larks)			Scł (Cr	Credit s	
	L	Р	Theory	Unit Test	Attend ance	Tutorial/as signments	TW	Pract/ Oral	ТН	TW/PR /OR	
Research Methodology	04		60	20	10	10	-		04	-	04
FACTS and HVDC	04		60	20	10	10	-		04	-	04
Advanced Microcontroller & Its Applications	04	02	60	20	10	10	25	25	04	01	05
Power System Modeling	04	02	60	20	10	10	25	25	04	01	05
Total	16	04	240	80	40	40	50	50	16	02	18

SemesterII	erII TotalDuration:20 hrs/week TotalMarks:500 TotalCredits:18											
Subjects	Teac Scheme Hrs./V	hing e(Hrs) Veek			Examinatio (Mar	Examination Scheme (Credits)		Total Credits				
	L	Р	Theory	Unit Test	Attendan ce	Tutorial/ assignme nts	TW	Pract/ Oral	TH	TW/PR/ OR		
Power Systems Dynamics	04		60	20	10	10			04	-	04	
Digital Protection of Power System	04	02	60	20	10	10	25	25	04	01	05	
PLC& SCADA	04	02	60	20	10	10	25	25	04	01	05	
Elective-I	04		60	20	10	10			04		04	
Total	16	04	240	80	40	40	50	50	16	02	18	

SemesterIII TotalDuration:28hrs/w TotalMarks:500 Total Credits: 40											
Subject	Teac Schem Hrs./	ching e(Hrs) Week			Examination	onScheme			Exam Scl (Cr	Total Credits	
	L	Р	Theory	Unit Test	Attenda nce	Tutorial/ assignme nts	TW	Pract/ Oral	TH	TW/PR /OR	
Power QualityIssues	04	02	60	20	10	10	25	25	04	01	05
Elective-II	04	02	60	20	10	10	25	25	04	01	05
Self-Study Paper-I	04		60	20	10	10	I	-	04	I	04
Dissertation Stage –I	-	07	-	-			25	25		21	21
Seminar	-	05	-	-			25	25	-	05	05
Total	12	16	180	60	30	30	100	100	12	28	40

Elective-I	Elective- II
a) PowerSectorRestructuring&Deregulationb) Powersystemplanning&reliability	a) AdvancedControlsystemb) AdvancedPowerElectronics&Drives

SemesterIV	lDuration:14 hrs/week otalMarks:325 Total redits: 34										
Subject	Teac Schem Hrs./	ching ne(Hrs) Week		ExaminationScheme						Examination Scheme (Credits)	
	L	Р	Theory	Unit Test	Attendanc e	Tutorial /assignm ents	TW	Pract/ Oral	TH	TW/P R/OR	
Self-Study Paper-II	04		60	20	10	10	-	-	04	-	04
Dissertation Stage –II	-	10	-	-		-	150	75		30	30
Total	04	10	60	20	10	10	150	75	04	30	34

ListofSelfStudypaperI&II

SelfStudyPaperI	SelfStudyPaperII
ConditionMonitoringofElectricalEquipments	ElectricalPowerCapacitors
EnergyStorageDevices	Nanotechnology&itsapplicationsinElectrical
	Engineering
DigitalMeasurementTechniques	Highvoltageinsulationsystem&design
EnergyConservation&Audit	Useofsynchronized measurement techniques in
	powersystem
SolarPV&Windenergysystems	DistributedGeneration
Demandresponse&demandsidemanagement	SmartGrid-AutomationSystemforState
	TransmissionUtility
DigitalSignalProcessingApplicationsinPower	Substationdesign
Systems	

		RESEARCHMETHODOLOGY		
TEACHIN	NGSCHEME:	EXAMINATIONSCHEME:	CREDITS ALLOTTED	:
Theory:04	Hours/Week	EndSemesterExamination:60 Marks	04 Credits	-
		ContinuousAssessment:40Marks		
UNIT-I	Fundamentals	•		(08Hours)
	Definition,Research	Characteristics, ResearchNeed, Objectives and	vpesof	
	research. Motivation	and objectives – Research methods vs Mo	ethodology.	
	Typesofresearch-De	scriptivevs. Analytical. Appliedvs. Fundamenta	ıl.	
	Quantitativeys.Quali	tative.Conceptualys.Empirical	,	
UNIT-	Formulationofresear	chproblem		(08Hours)
11				
	ResearchFormulation	h-Defining and formulating the research problem	n-	
	Selecting the problem	n -Necessity of defining the problem - Import	tance	
	ofliteraturereviewind	lefining aproblem–Literaturereview–Primary	and	
	secondarysources – 1	eviews, treatise, monographs-patents – web a	as a source	
	- searching the web	- Critical literature review – Identifying gap a	reas from	
	literaturereview-			
	Developmentofwork	inghypothesis.SummarizingaTechnicalPaper	-	
	summarytemplate,O	nlinetools -Google, CiteSeer, ACM		
	DigitalLibrary,IEEE,Theon-lineComputerScience bibliography,			
	Searchingpatents	-		(0.077
UNIT- III	Researchdesignmethe	ods		(08Hours)
	Research design, sar	npling design and scaling techniques – Resea	rch design-	
	Basic Principles- N	eed of research design — Features of goo	d design –	
	Important concepts	s relating to researchdesign, basic pri	nciples of	
	experimentaldesigns	,implicationsofsampledesign,stepsinsamplede	esign,	
	criteria of selecting	sampling procedure, characteristics of goo	d sampling	
	design, different types	ofsampledesign.Scalingtechniques: measurem	nent	
	scales, sources of err	or, technique of developing measurement too	l, important	
	scaling techniques, s	cale construction techniques.	· •	
UNIT- IV	Statisticalanalysis	*		(08Hours)
	Data Collection and	analysis:- Observation and Collection of n	rimary and	
	secondarvdata -N	lethodsofdatacollection.processingoperations.	types of	
	analysis, statistics i	n research measures of central tendency. n	neasures of	
	dispersion, measure	es of asymmetry, measures of relationshi	ps. simple	
	regression analysis,	multiple correlation and regression, partial co	rrelation.	
TINTE		-1141		(0011)
V	KesearchPaper&The	siswriting		(USHOURS)
	Reportingandthesisw	riting-Structureandcomponentsof scientificre	eports	
	- Types of report -	Technical reports and thesis - Significance	 Different 	
	steps in the preparat	ion – Layout, structure and Language of typic	al reports –	
	Illustrations and ta	bles - Bibliography, referencing and footno	otes - Oral	
	presentation – Plann	ing – Preparation – Practice – Making present	ation –	

	Useofriquel aide	Importance of affective communication Decumentation	
	Useoivisual alus - I	Inportance of technical nearers - Lournel nearers	
	and presentationtools	S. LATEA. Types of technical papers - Journal papers,	
	Conference papers,	Survey papers, Poster papers, Review papers	
	Comparison, Struct	ure of a survey, conference and journal paper,	
	Organizationandflow	ofthesis/Projectreport,Researchproposal:	
	preparation, budgeti	ng, presentation, funding agencies for engineering	
	research,		
UNIT- VI	Researchethics, IPR:	andpublishing	(08Hours)
	Ethics: ethical issues.		
	IPR: intellectual pro	poperty rights and patent law, techniques of writing a	
	Patent, filing procedu	re, technology transfer, copy right, royalty, traderelated	
	aspects of intellect	ual property rights Publishing: design of research	
	paper.citationandack	nowledgement.plagiarismtools.reproducibilityand	
	accountability.	······································	
TextBooks	:		
1.Kotł	nari,C.R.,ResearchMet	hodology:MethodsandTechniques.NewAgeInternational	
2.Garg	g,B.L.,Karadia,R., Aga	rwal, F.and Agarwal, U.K., Anintroduction to Research	
Me	thodology,RBSAPubli	shers	
3.Sure	shSinha,AnilKDhimar	n,ResearchMethodology,ESSPublications,Volumes2	
4.Day	R.A.,HowtoWriteandP	ublishaScientificPaper,CambridgeUniversityPress	
5.Wad	lehra, B.L. Lawrelating	topatents, TradeMarks, copyright designs and geographical	I
ind	ications.UniversalLaw	Publishing	
Reference	Books:		
1.Lou	isCohen, LawrenceMa	nionandKeithMorrison,ResearchMethodsinEducation,7th	
Ed	lition,CambridgeUnive	rsityPress,ISBN -978-0415-58336-7	
2. A	nthony,M.,Graziano,A	.M.andRaulin,M.L.,ResearchMethods:AProcessof	
Inc	quiry,AllynandBacon		
3. R	anjitKumar,ResearchM	Iethodology:AStepbyStepGuidefor Beginners,2ndEdition	,
AI	PHPublishingCorporati	on	
4.Leed	ly,P.D.andOrmrod, J.E	., PracticalResearch: PlanningandDesign, PrenticeHall	
5. Fi	nk,A.,ConductingRese	earch LiteratureReviews:FromtheInternettoPaper.Sage	
Pu	blications		
6.Lesl	ie Lamport, 'Latex:Ado	ocumentpreparation system'AddisonWesley,Reading,	
Ma	ssachusetts, second		
Syllabusfo	rUnitTest:		
UnitTest-1		UNIT–I,UNIT –II,UNIT-III	
UnitTest-2		UNIT–IV,UNIT –V,UNIT-VI	

		FACTS& HVDC			
TEACHIN	GSCHEME:	EXAMINATIONSCHEME:	CREDITS D:	ALLOTTE	
Theory:04H	lours/Week	EndSemesterExamination:60Marks	04 Credits		
		ContinuousAssessment:40Marks			
	1				
UNIT-I	FACTS:			(08Hours)	
	Conventional me reactors, Phase sl AC transmission converter structu topologies,Conve controlissues	thods to increase transmission capacity, nifting transformers, Synchronous conden controllers Basics, Challenges and needs, res, AC controller based structures, DC I rteroutputandharmoniccontrol,Powerconv	Series, Shunt sers, Flexible Static Power ink converter erter		
UNIT-II	ShuntandSeries	Compensation:		(08Hours)	
	Operation and control of thyristor controlled reactor, Thyristor switched Capacitor, SVC, STATCOM configuration and control, Applications of SVC, Power oscillation damping, Mitigation of sub-synchronous resonance, TCSC operation, Layout and protection, Applications of TCSC StaticSynchronousSeriesCompensator(SSSC)				
UNIT-III	UnifiedPowerFle	ow Controller:		[08Hrs]	
	UPFC configuration, Independent real and reactive power flow control, Control scheme for UPFC, Basic control system for P and Q control, Dynamic performance, Operational constraints of UPFC, Power flow studies in UPFC embedded systems				
UNIT-IV	GeneralBackgro	(08Hours)			
	EHV AC versus HVDC link - Mo HVDC link, Equ phase six pulse a waveforms.Effec ControlofDCvolta	s HVDC Transmission, Different conf onopolar, Bipolar, Back to Back, Power lation for HVDC power flow, Connect nd twelve pulse converter bridges, Voltag tofdelayangle,Extinctionangle,Overlapang age	igurations of flow through ions of three ge and current gle,		
UNIT-V	MultiTerminal	HVDC:		(08Hours)	
	BipolarHVDCterminal, Convertertransformerconnections, Switching arrangements in DC yard for earth return to metallic return, HVDC switchingsystem,SwitchingarrangementsinabipolarHVDCterminal, Sequence of switching operations, HVDC circuit breakers, DC current interruption,Commutationprinciple,Probabletypesandapplicationsof HVDC circuit breakers, Multi-terminal HVDC systems, Parallel tapping, Reversal of power, Configurations and types of multi-terminal HVDCsystems,Commercialmultiterminalsystems				
UNIT-VI	ProtectionandC	ontrol:		(08Hours)	
	Faults and abnorn Pole-wise segreg reenergizing, Pro DCyards,Integrat control,Blockdiag	mal condition in bipolar, Two terminal H ation, Protective zones, Clearing of DC H tection of converters, Transformer, Con- ionofprotectionandcontrols,Hierarchicalle gram,Schematicdiagram,Currentcontrol,Po	VDC system, ine faults and verter valves, velsof ower		

	control,DCvoltagecontrol,Commutationchannel,Mastercontrol,					
	Stationcontrol,Leadstation,Trailstation,Polecontrol,Equidistant firing	ng				
	control, Synchronous HVDC link, Asynchronous HVDC Link					
TextBooks:						
1.E.Acha	a, V.A. Agelidis, O. Anaya-laraand TJEMiller Newnes, Power Electronic	controlin				
Elec	ctricalSystems Oxford.					
2.N.G.Hi	lingoraniandL.Gyugi,UnderstandingFACTS-IEEEPress,New York.					
3.J.Arrila	laga, Y.H.LiuandN.R.Watson, FlexiblePowerTransmission-TheHVDC	Options,				
JohnW	WileyandsonsLtd.,NewYork.					
ReferenceBo	Books:					
1.T JEMi	Ailler, "ReactivePowerControlin ElectricSystems", John Wiley					
2. Padi	2. PadiyarKR"FACTSControllersinPowerTransmission&Distribution",NewAge.					
3. R.M.	AohanandR.K.Varma, "Thyristor-BasedFACTSControllersforElectrica	alTransmission				
Systems", IEEEPress.						
SyllabusforU	CUnitTest:					
UnitTest-1	UNIT–I,UNIT–II,UNIT–III					
UnitTest-2	UNIT–IV,UNIT–V,UNIT–VI					

AdvanceMicrocontrollersandapplications						
TEACHINGSCHEME: EXAMINATIONSCHEME: CRED D: D:				ALLOTTE		
Theory:04H	ours/Week	EndSemesterExamination:60Marks	04 Credits			
		ContinuousAssessment:40Marks				
		TW&OR:50 Marks	01 Credits			
		·	·			
UNIT-I	IntroductiontoPIC architectureandin programmemoryc CPU registers.	C16F8XXfamilyanddevelopmenttools.CPU structionset.Harvardarchitectureandpipelin considerations,registerfilestructureandaddre	J ling, essing modes,	(08Hours)		
UNIT-II	PICperipherals I/Oports,externali	nterruptsandtimers,timeroperation,ADC,sl erial port, serial peripheral interface I2C bu	hort overview 1s.	(08Hours)		
UNIT-III	Learning MPLA environmentfrom applications like matrix keyboard	AB (V 5.0 or above) Integrated Microchip(Assemblerandsimulator),Study motor control, temperature control, lamp d and LCD interfacing etc.	development of immer, 4X4	(08Hours)		
UNIT-IV	ARM & AVR Processors : RISC, ARM design philosophy, ARM fundamentals, instruction set, thumb instruction set, exception & interrupthandling, efficientCprogramming,optimizingARMassembly code,AVRarchitecture,instructionset,hardwareinterfacing,(08Hours)					
UNIT-V	Interfacingconsiderations:Intelprocesscommunication,(08Hours)synchronizationofprocesses,tasks,threads,devices&busesfornetworks,hardware-softwareco-designembeddedprogrammingin C/RTLinux					
UNIT-VI	Linux(08Hours)Real time operating systems: Survey of software architectures- round robin, with interrupts, function queue scheduling, RTOS architecture, selecting an architecture, task states, task and data semaphores and shared data, message queues, mailboxes ,pipes, timer functions, events, memorymanagement,interruptroutinesin anRTOSenvironment,basic designusingRTOS,embeddedsoftwaredevelopmenttools,Micro C/OS-II,VXworks.(08Hours)					
ReferenceB 1. Micr 2. Desi 3. Rajk editi	ooks: rochipPICfamilyMi ignwithPICmicroco camal,''Embeddeds ion2003	crocontrollerhandbook ntrollers–JohnPeatman,PearsonEducation ystem–architecture,programminganddesig	Asia,LPE n",TMHPublic	ation,		
4. Dav 5. Jona inter	idSimon,"Anembed thanW.Valvano,Br facing"ThomsonLe	IdedsoftwarePrimer",Pearsoneducation, Asooks,Cole"EmbeddedMicrocomputersyste earning	sia ems-Realtime			
Syllabusfor	UnitTest:					
UnitTest-1		UNIT–I,UNIT–II,UNIT–III				
UnitTest-2		UNIT-IV.UNIT-V.UNIT-VI				

	PowerSystemModeling			
TEACHING	SCHEME:	EXAMINATIONSCHEME:	CREDITSALLO	TTED:
Theory:04	Hours/Week	EndSemesterExamination:60Marks	04Credits	
		Continuous Assessment: 40 Marks		
		PR&OR:50Marks	01Credits	
UNIT-I	ModelingofNon-Electr	calParameters:		(08Hours)
	Differentareasofpowe	systemanalysis, Need formathematical modeli	ngof	
	powersystem,Simplifie	Imodelsofnon-	_	
	electricalcomponentss	ichasboiler, steam & hydroturbine, governors y	stem	
UNIT– II	ModelingofTransform	ers:		(08Hours)
	Transformermodelingf	ortwowindingtransformer,tap-changer,phase	shifting	
	transformer, threewind	ngtransformerandauto-transformer		
UNIT– III	ModelingofTransmissi	onLine:		(08Hours)
	Modelingoftransmissic	nnetwork, Transformation to Alpha-Betacompo	onents	
	usingD-Qcomponents,	teadystateequations		
UNIT– IV	SynchronousMachine	1odeling:		(08Hours)
	Introduction, Park's T	ansformation, Flux Linkage Equation, Volt	age Equations,	
	FormulationofState-			
	SpaceEquation,Current	Formulation,PerUnitConversion,Normalizing	/oltageequatio	
	ns,NormalizingTorque	quations,Torque&Power		
	EquivalentCircuitofSyn	hronousMachine		
UNIT– V	ExcitationSystemMod	ling:		
	Typesofexcitationsyste	${\tt ms}$, Controland protective systems, Modeling of	excitationsyste	(08Hours)
	ms(excitationsystemco	mponentsandentireexcitationsystem,		
	VoltageResponseRatio	Excitervoltageratings		
UNIT–VI	LoadModeling:			
	BasicLoadModelingcon	cepts, Staticload representation, Dynamicload	epresentation,I	(08Hours)
	nductionmotor(asload)	modeling, synchronous motor (asload)		
	modeling, acquisition of	oadmodelparameters		
1.K. Padiy	ar",PowerSystemDynam	ics", B.S. Publications		
2.JohnJ.Gr	anier&W.D.StevensonJr	"PowerSystemAnalysis",4"Edition,McGrawF	illInternational	
	ILEUILION	retene The serve Are Letters de stisse?" TMUDech lighin of	Domenous OndEditio	
3. UlleEl	r "DoworSystem Dungers	semineory-Ammroauction, IMHPublishing	ompany,2 Editio	011
4. Kundu	r, PowerSystemDynamic	Sacontrol , IEEEPress, New York		
Reference	Books			
1 Ande	arson&Foud "DowerSyst	mControl&Stability" Vol-LIEEEDross NowVor	,	
ב.אווענ יי ס ח כ יי	Murthy "PowerSystem	veration&Control"	N	
2.7.3.1	viuitiliy, rowersystemo			
Syllahusfo	rl InitTest [.]			
UnitTect_1		NIT- NIT-II		
UnitToct_?				
UnitToct_2				
Unit lest-5				

	PowerSystemDynamics					
TEACHI	NGSCHEME:	EXAM	NATIONSCHEME:		CREDITSALLC	OTTED:
Theory:	04Hours/Week	EndSe	nesterExaminatior	n:60Marks	04Credits	
		Contin	uousAssessment:4	0Marks		
UNIT-I	ClassicalMethodsofP	owerSyst	emDynamicStudie	S		(08Hours)
	Equalityandinequality	constrair	tsinpowersystemo	peration, state trans	itiondiagram,c	
	onceptofsystemsecur	ityandsta	bility,classicalmode	elofsystemofonema	chineconnect	
	edtoinfinitebus,Clarko	diagramto	ortwomachinesseri	esreactancesystem,	extensionofCl	
	arkdiagramtocoveran	yreactan	cenetwork,			
	SmallSignalStability:	veranpow	ersystem			(08Hours)
	Smallsignalanalysis ar	nalvsisofs	unchronizing&dam	ningtorque stateequ	ationforsmall	(00110013)
	signalmodel Simplifie	dsvnchro	nousmachinemode	l calculationofinitia	conditions sv	
	stemsimulation.impro	ovedmod	elofsvnchronousma	achine.small	condicions)sy	
	signalstabilityofmultir	machines	ystem	-,		
UNIT-III	LargeSignalAnalysis:					(08Hours)
	Elementaryviewoftra	nsientstal	oility,Largesignalan	alysis, Analysisusing		
	numerical integr	ation	methods (N	Nodified Euler's	s, Runge-	
	Kutta),Simulationofpo	owersyste	mdynamicrespons	e, Analysis of unbalar	cedfaults,Cas	
	estudyofalargesystem	1				
UNIT-IV	PowerSystemStabiliz	ers:				(08Hours)
	Basicconceptsofcontr tuning,Fieldimplemer	olsignalsi ntation,PS	npowersystemstab Sdesignandapplica	vilizers (PSS), Structur tion, Futuretrends	eand	
UNIT-V	Multi-machinesystem	า:				(08Hours)
	Simplifiedmodel,Impr	ovedmod	lelofthesystemforli	nearload,Inclusiono	fload	
	andSVC,Introductiont	oanalysis	oflargepowersyste	m		
UNIT-VI	Voltagestability:					(08Hours)
	Definition,Factorsaffe	ctingvolt	agestability&collap	se,Analysis&compa	risonofangle&	
	voltagestabilityandvo	ltageinsta	bility&collapse,Co	ntrolofvoltageinstat	oility,islanding	
	-necessity,methods,a	dvantage	sanddisadvantages	,		
	implicationonpowers	ystemdyr	amicperformance			
TovtBoo						
1.	Anderson&Foud."Power system	nControl&S	tability".IEEEpress.Ne	ewYork		
2.	OlleElgerd, "ElectricalEnergySy	/stemTheor	y-An Introduction", TM	H		
Referen	ceBooks:		, , , , , , , , , , , , , , , , , , ,			
1.	KRPadiyar, "PowerSystemDyna	mics",BSP	ublications			
2.	PrabhaKundur,"PowersystemSt	ability&cor	trol",TMH			
3.	C.W.Taylor,"PowerSystemVolt	tageStabilit	/", TMH			
4.	R.A.Walling,"DistributedGener	ationIsland	ing",N.W.Miller			
	• · · · • =					
Syllabus	sforUnitTest:					
UnitTest	t-1	UNIT-	I,UNIT–II,UNIT–III			
UnitTest	t-2	UNIT-	IV,UNIT-V,UNIT-V	1		

	DigitalProtectionofPowerSystem				
TEACHINGS	CHEME:	EXAMINATIONSCHEME:	CREDITSALLO	TTED:	
Theory:04H	ours/Week	EndSemesterExamination:60Marks	04Credits		
		ContinuousAssessment:40Marks			
		TW&OR:50Marks	01Credit		
UNIT-I	Introduction:			(08Hours)	
	NeedforPowersystemprote	ection, Digital Protection: State of Art, Meritso	fMicroprocessor		
	relayingscheme, PowerSyst	emComponents, Basic Philosophy of Protecti	onScheme,Secti		
	onofProtectionScheme,Cir	cuitBreakers and Relays, Types			
	andApplications.Architectu	ıreofModernDigitalRelay			
UNIT-II	StaticRelays:			(08Hours)	
	IntroductiontoStaticRelay,	OvercurrentRelay, DistanceRelay, Protection	Schemesoftrans		
	missionlines,Switcheddista	ncerelay, Poly-phaserelay, Relayas Compara	tor-		
	DualinputComparator,Rela	ycharacteristicsbycomparisonofconstants, I	∕lulti-		
	inputcomparator,PilotRela	yingScheme			
UNIT-III	ElementsofDigitalProtection	on:		(08Hours)	
	Basiccomponentsofadigita	Irelay,Signalconditioningsubsystem:Transd	ucers,Surgeprote		
	ctioncircuits, Analogfilterin	gandanalogmultiplexers,Conversionsubsyst	ems,SamplingTh		
	eorem, Digital filtersignalali	asingerror,Sampleandholdcircuit,Digitalmu	ltiplexing,Digitalt		
	oanalogconversion, Analog	todigitalconversion,Digitalrelay			
	subsystem, Digital relayasur	nit			
UNIT– IV	DigitalProtectionofTransm	lissionLine:		(08Hours)	
	Protectionschemeoftransm	nissionline, Distance Relay, Travelling wave rel	ays.Digitalprote		
	ctionschemebasedonfunda	mentalsignal:hardwaredesign,softwaredes	ign,Digitalprotec		
	tionofEHV/UHVtransmissio	onlinebasedontravellingwave			
	phenomena, Newrelayings	chemeusingamplitudecomparison		(00)	
UNII-V	DigitalProtectionof I ransfo	ormerandSynchronousGenerator:		(08Hours)	
	Faultsin Fransformer, Schen	nesused for I ransformer Protection, Digital Pr	otectionofTransfo		
	rmer FaultsinSunchronousganor	ator Drotoctions chamasfar Supphranous cor	orator Digital Drat		
	Faultsinsynchronousgener	ator, Protectionschemestor Synchronousger	lerator,DigitalProt		
	ArtificialIntelligencoinBow	ralor		(08Hours)	
	Introduction AnExportSyste	ersystem rotection.	tion BroblomDos	(USHOUIS)	
	cription ESApproach Typic	Application Euzzyl ogic(EL) for Powersyster	nProtection Intr		
	aduction Problem Description	ion El Approach ArtificialNeutralNetwork(A	NNI)inPhaseSele		
	ction:Introduction Problem	Description Measurementoffaultgenerate	dinhighfrequenc		
	vcomponents ANNApproa	-h	uninginiequene		
	,				
ToytBooks					
1 "Digit	alProtection ProtectivePola	vingfromElactro MachanicaltoMicroprocos	cor" Dul D Singh 2nd		
I. Digit. Edit	tion Reprint-2004 NewAgeIn	ternational Publisher New-Debli	SUI DYL.P.SIIIgII.Z		
2 "Digit	alpowerSystemProtection"P	vS R Bhide PHILearningDrivateLimited New	 /Delhi		
2 "Ar+:fi	icialIntelligenceTechniquesir	DowerSystems" ByKevinManuick AuthorEl			
D. Artin Puh	lication:InstitutionofFlectric	alEngineers London, UK	wucanajAggai Wdl,		
	alProtectionforPowersyster	p ^r hyA Tlohnsands K Salman DeterDerogrinu	ist the OfThe Institute		
ofEl	lectricalEngineers,London,U	nitedKindom.			
5."SoftC	ComputingTechniquesandits	ApplicationsinElectricalEngineering"ByDr.D	evendra Chaturvadi	,	

 Publication:Springer-VerlagBerlinHeidelburg.

 ReferenceBooks:

 1. "PowerSystemProtection4:DigitalProtectionandSignalling"editedbyETAElectricityTraining Association.PublishedbyInstituteofEngineers,London,UK.

 2. "DigitalSignalProcessinginPowerSystemProtectionandControl"ByWaldemarRebizant,JanuszSzafran,Andrzej Wiszniewski.

 SyllabusforUnitTest:

 UnitTest-1
 UNIT-I,UNIT-II,UNIT-III

 UnitTest-2
 UNIT- IV,UNIT-V,UNIT-V,UNIT-VI

	PLCandSCADA				
TEACHINGSC	CHEME:	EXAMINATIONSCHEME:	CREDITSALLC	OTTED:	
Theory:04Ho	ours/Week	EndSemesterExamination:60Marks	04Credits		
		ContinuousAssessment:40Marks			
		TermWork:50Marks	01Credits		
	1				
UNIT-I	Introductionto PLC			(08 Hours)	
	Definition&HistoryofPLC,	OverallPLCsystem,PLCInputandOutputmodule	s,CPU,Interfac		
	es,Powersupplies,PLCadv	antagesanddisadvantages, Selectioncriteriafor	PLC,Architectu		
	reofindustrialAutomation	1Systems, Process Control, PIDControl, Predictive	2Control,Introd		
	Hardwareenvironment	i,PLCSanukelayLauderLogic,			
UNIT-II	PL CProgramming			(08 Hours)	
	Programmingequipment	s.Construction of PL Cladderdiagram.Basiccomp	onentsandsym	(00 110415)	
	bolsinladderdiagram,Lad	derlogic,Functionalblock,Structuraltext,Instruc	tion,troublesh		
	ooting,features,program	mingON/OFFInputstoproduceON/OFFoutputs,	NetworkingofS		
	ensors, Actuators and Cont	trollers:TheFieldbus,The	_		
	FieldbusCommunication	Protocol			
UNIT-III	PLCApplications			(08 Hours)	
	AnalogPLCoperation,PID	controlof continuous processes, simple closed loc	opsystems,clos		
	edloopsystemusingPropo	ortional,Integral&Derivative(PID),PLCinterface,	MotorsControl		
	s:ACMotorstarter,ACmot	oroverloadprotection, DC			
UNIT IV	SCADA	speed(variableFrequency)AChlotorDrive		(08 Hours)	
	NeedofSCADAsystem Fea	atures SCADAarchitecture-		(00 110013)	
	Firstgeneration Seconda	phonetation Thirdgeneration HMI MTU BTU JED'	5 7 Lovers of		
		ion requirements for SCADA (communic	s, 7 Layers of		
	DND ICC Ethornot TCD/ID	Madhus UDD) Client			
		innoubus, ODP), chent-			
	Serverbasedcommunicat	ionconcept,SCADABenefits		(00 11	
UNII-V	SCADAInPowerSystem			(08 Hours)	
		lerconnectedpowersystem, Automaticsubstati	oncontrol,SCA		
	Stateestimation SCADAs	vstemsecuritvissuesoverview			
UNIT-VI	SupervisoryManagemen	nt		(08Hours)	
	NetworkedSCADAenviror	nmentwithimplementationexamples, Substatio	nAutomationan	. ,	
	dEquipmentconditionmo	nitoringusingSCADA, Distributionsystemdesign	mapping,troubl		
	ecallmanagement,Custor	nerlevelintelligentautomation			
	system,computerlevelmo	onitoringandcontrolofequipments			
TextBooks:	<i>"</i> >				
1.Terson	,"PowerSystemControllec	nnology", Prentice Hall	<u> </u>		
2.Green,	J.N,WIISON,K,"ControlandA	AutomationofElectricPowerDistributionSystem	s, laylorand		
3 Turner	W C "EnergyManagement	Handbook" 5 th Edition 2004			
4 GaryDi	inning "IntroductiontoPro	grammahlel.ogicControllers ⁷ Thomson 2 nd Editi	on		
5. JohnW	Webb.RonaldA.Reis."Prop	rammableLogicControllers:PrinciplesandAppli	cation".5 th Edition	1	
6.Stuart4	ABoyer, "SCADAsupervisory	controlanddataacauisition"			
		1			

1.Handschin, E. "Energy Management Systems", Springer Verlag, 1990			
cticalModemSCADA Protocols"			
SyllabusforUnitTest:			
UNIT–I,UNIT –II,UNIT-III			
UNIT–IV,UNIT –V,UNIT-VI			

(Elective–I)PowerSectorRestructuring&Deregulation				
TEACHING	SCHEME:	EXAMINATIONSCHEME:	CREDITSALLOTTE	<u>D:</u>
Theory:04	Hours/Week	EndSemesterExamination:60Marks	04Credits	
		ContinuousAssessment:40Marks		
UNIT-I	PowerSectorinIndia			(08
	Introductiontovariousinst	itutionsinanIndianPowersectorsuchasCEA,Planr	ingCommissions,P	Hours)
	GCIL, PFC, Ministry of Powe	r,StateandCentralgovernments,REC,LoadDispate	chCenters, Utilities	
	andtheirroles.Criticalissue	es/challengesbeforetheIndianpowersector,Elect	ricityact2003-	
	ProvisionintheGeneration	, Transmission & Distribution		
	Sector, Various national po	liciesandguidelinesunderthisact.		
UNIT-II	FundamentalsofEconomi	cs&PowerSectorRegulation		(08
	Fundamentalsofeconomic	csapplicabletoPowerSector,Consumerbehavior,S	Supplierbehavior,	Hours)
	MarketEquilibrium,Short-	run&Long-runcosts,Variouscostsofproduction-		
	Totalcost(TC),Averagefixe	dcost(AFC),Averagevariablecost(AVC),Averagec	ost(AC)andMargi	
	nalcost(MC),Relationship	betweenshort-runandlong-		
	runaveragecosts,Perfectly	competitivemarket,Conceptoflifecyclecost,Ann	ualrateofreturn,	
	methodsofcalculationsofl	nternalRateofReturn(IRR)andNetPresentValue(I	NPV)ofproject,Ro	
		onofregulatorycommissioninindia, i ypesandmet	nodsof	
	economicregulation, Regu	latoryprocessifilitula.		
	DoworToriff			(00
	Power larin Differenttarifferinciples/n	parginal cost cost to convo avorago cost)		80)
	Consumertariffstructures	and considerations different consumer categories	stelesconictariff	Hoursj
	fixed and variable charges t	imeofday interruntibletariff and different tariffb	asednenaltiesan	
	dincentivesetc. Subsidvar	adcrosssubsidy lifelinetariff Comparisonofdiffere	enttariffstructure	
	sfordifferentloadpatterns	.Governmentpolicies inforce from		
	timetotime.Effectofrenew	vableenergyandcaptivepowergenerationontarif	Availabilitybase	
	dtariff,Latestreformsanda	mendments	, ,	
UNIT-IV	Powersectorrestructuring	gandmarketreform		(08
	Introductiontopowersect	orrestructuring,Reasonsforrestructuring/deregu	lationofpowerin	Hours)
	dustry, Understanding the	restructuringprocess-		
	Entities involved, The levels	sofcompetition, Themarketplacemechanisms and	Sector-	
	wisemajorchangesrequire	ed, Different industry structures and ownership mo	dels,Marketmod	
	elsbasedoncontractualarr	angements-		
	MonopolyModel,Singlebu	yerModel,WholesalecompetitionmodelandReta	ailcompetitionmo	
	del,Marketarchitecture,Ti	melineforvariousenergymarkets, Bilateral/forwa	ardcontracts, Thes	
	potmarket, Modelsfortrad	ingarrangements,ISOorTSOmodel,Reasonsando	bjectivesofdereg	
	ulationofvariouspowersys	stemsacrosstheworld-		
	TheUS,TheUK,TheNordicP	oolandThedevelopingcountries.Congestion		
	Management, Ancillary Ser	rvices		

UNIT-V	FlectricityMarketsPricing	andNon-priceissues	(08	
	Electricitypricebasics.Mar	ketClearingprice(MCP).ZonalandlocationalMCPs.Dynamic.spotpr	Hours)	
	icingandrealtimepricing D	ispatchbasedpricing Powerflowsandprices OptimalpowerflowSp	,	
	otoricesforrealandreactiv	enower Unconstrainedreals not prices constrains and reals not price		
	es Nonpriceissuesinelectr	icity restructuring (quality of cupply and carvice environmental and c		
	es.Nonpricessuesmelecti	alovnorion.cowith		
	ocial considerations), diob			
	electricityreformsindiffere	entcountries.		
	TronomiosionDlonningon		(00	
UNIT-VI		irricing	80) (
		perationinopenaccesspowersystems, introduction&Principlesoftra	Hours)	
	nsmissionpricing,Differen	ttransmissionpricingmethods, I ransmission costallocation method		
	s,Marginal&Compositepri	cingParadigms&theircomparison,Introductiontotransmissionloss		
	allocation&variousmetho	ds of loss allocation, Debated issues in transmission pricing, Congestio		
	nissuesandmanagement,A	AncillaryServiceManagement,Forwardancillaryserviceauction.Po		
	werpurchaseagreements.			
Reference	Books:			
1. LoiLei	Lai, 'PowerSystemRestructu	ring&Deregulation,JohnWiley&SonsLtd.		
2. "Know	vYourPower", AcitizensPrim	erOntheElectricitySector,PrayasEnergyGroup,Pune		
3. SallvH	unt."MakingCompetitionW	orkinElectricity".2002.JohnWilevInc		
4. Electri	icUtilityPlanningandRegulat	ion.EdwardKahn.AmericanCouncilforEnergyEfficientEconomy		
5 DSKi	5 D S Kirschen&G Strbac 'EundamentalsofPowerSystemEconomics' JohnWiley&Sons1td			
5. D.S.NI Schenked. Stilbac, FundamentalsofFower System Economics, John Wiley Johnston.				
7 MSba	hidonour HatimVamin Zuvil	i 'MarketOperationsinElectricalDowerSystems Ecrocacting School	uling	
7. IVISITA	isk Management' Wiley Int	ar Science	unng	
	isk management, whey mu			
References	5:			
1. Regula	tionininfrastructureService	s:Progressand the way forward-TERI, 2001		
2. Mahar	ashtraElectricitvRegulatorv	CommissionRegulationsandOrders-www.mercindia.com		
3. Variou	spublications, reports and pr	esentationsbyPravas.EnergyGroup.Punewww.pravaspune.org		
4. Centra	IFlectricityRegulatoryComm	nission RegulationsandOrders-www.cercind.org		
5 Electric	cityAct2003andNationalPol	icies-www.powermin.nic.in		
6 Marke	tOperationsinFlectricPower	SystemsEprecasting SchedulingandRiskManagement-		
0. Mahke	nmadShadenur HatimVatim			
www.corright.com/www.com/www.com/wwww.com/wwww.com/wwww.com/wwww.com/wwww.com/wwww.com/wwwww.com/wwww.com/wwww.com/wwwwwwwwww				
7. Dilaliu	впизнан, авсогавт-арпп	eronAvailabilityrann -www.cercinu.org		
Wabsita				
WEDSILE.IN				
Syllabusfo	rUnitTest:			
UnitTest-1		UNIT– I,UNIT–II,UNIT–III		
UnitTest-2		UNIT– IV,UNIT–V,UNIT–VI		

(Elective–I)POWERSYSTEMPLANNINGANDRELIABILITY					
TEACHINGSCHEME:		EXAMINATIONSCHEME:	CREDITSALLOTTED	<u>):</u>	
Theory:04Hours/Week		EndSemesterExamination:60Marks	03Credits		
Practical:02Hours/Week		ContinuousAssessment:40Marks			
		TermWork:25Marks	01Credit		
UNIT-I	Unit1:LoadForecasti	ng:		(06	
				Hours)	
	Introduction, Factors	affectingLoadForecasting,LoadResearch,Load	GrowthCharacteristics		
	,ClassificationofLoad	and Its Characteristics, Load Forecasting Method	ds		
	-(i)Extrapolation(ii)C)-			
	RelationTechniques,	EnergyForecasting,PeakLoadForecasting,Reac	ctiveLoadForecasting,		
	Non-				
	Weathersensitiveloa	dForecasting, Weathersensitiveload Forecastin	ng,AnnualForecasting,		
	MonthlyForecasting,	IotalForecasting,Objectives&Factorsaffecting	gtoSystemPlanning,Sh		
	ort i ermPlanning,	a LongTorm Planning [10hrs]			
				(06	
	Omiz.Probabilitythe			Hours)	
	Introductiontoproba	hility Probability distributions Bandomyariable	es densitvanddistribut		
	ionfunctions Mather	natical expectation Binominal distribution Pois	sondistribution norm		
	aldistribution.expon	ential distribution. Weibull distribution. Normal			
	Gaussian,Gammaan	Betadistribution.Correlationandregression			
UNIT-III	Unit3:Reliability			(06	
				Hours)	
	Reliability,Failure,Co	nceptsofProbability,EvaluationTechniques(i)N	/JarkovProcess(ii)Recur		
	siveTechnique,Stoch	asticPrediction of Frequency and Duration of Lor	ng&Short		
	Interruption,Adequa	cyofReliability,ReliabilityCost.			
UNIT-IV	Unit4:GenerationPla	nningandReliability:			
	Objectives&Factorsa	ffectingGenerationPlanning,GenerationSourc	es,IntegratedResource		
	Planning, Generation	SystemModel,LossofLoad(CalculationandApp	roaches),OutageRate,C		
	apacityExpansion,Scl	neduledOutage,LossofEnergy,EvaluationMeth	ods.InterconnectedSys		
	tem,Factorsaffecting	interconnectionunder			
	EmergencyAssistance	2.		100	
UNII-V	Unit5: Transmission	lanningandReliability		(06)	
	TransmissionDlannin	and Poliability Introduction Objectives of Tran	emission Dlanning Not	noursj	
	workPeconfiguration	Systemand and Point Indices Datarequired for	r		
	CompositeSystemRe	liability			
LINIT-VI	Unit6.DistributionPl	anningand Reliability		(06	
	onto.Distribution i			Hours)	
	RadialNetworks-				
	Introduction.Networ	kReconfiguration,EvaluationTechniques.Inter	ruptionIndices.Effects		
	ofLateralDistribution	Protection, Effects of Disconnects. Effects of Pro	tectionFailure.Effects		
	ofTransferringLoads.	DistributionReliabilityIndices.Parallel&Meshe	dNetworks-		
	Introduction, BasicEv	aluationTechniques, Bus			
	BarFailure,Scheduled	Maintenance, Temporary and Transient Failure	e,WeatherEffects,Brea		
	kerFailure.	· · ·			

TextBooks:				
1.RoyBillinton&RonaldN.A	llan,ReliabilityEvaluationofPowerSystem-SpringerPublication.			
2.R.L.SullivanPowerSystem	Planning-,TataMcGrawHillPublishingCompanyLtd.			
3.Miler&Freund's,Probabili	tyandStatisticforEngineers,PearsonEducation,RichardJohnson.			
ReferenceBooks:				
1.X.Wang&J.R.McDonald,N	1odernPowerSystemPlanning–,McGrawHillBookCompany			
2. T.Gönen,ElectricalPow	2. T.Gönen, Electrical Power Distribution Engineering - McGraw Hill Book Company			
3.B.R.GuptaGenerationofE	ectricalEnergy–,S.ChandPublications			
4. A.S.Pabla,ElectricalPov	4. A.S.Pabla, Electrical Power Distribution Tata McGraw Hill Publishing Company Ltd.			
5.T.W.Berrie,ElectricityEconomics&Planning–,PeterPeregrinusLtd.,London				
SyllabusforUnitTest:				
UnitTest-1	UNIT– I,UNIT–II,UNIT-III			
UnitTest-2	UNIT– IV,UNIT–V,UNIT-VI			

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PowerQualityIssues

TEACHINGSCHEME:		EXAMINATIONSCHEME:		CREDITSALLOTTED:	
Theory:04Hours/Week		EndSemesterExamination:60Marks		04Credits	
		ContinuousAssessment:40Marks			
UNIT-I	Voltagesag;swellsa	and interruptions			[8Hrs]
	Introduction; impor d.1159. Sources & Ef timation of voltages erlevel; utility syster starting sags; evalua	tanceofpowerquality;termsanddefinition fectsofPowerQualityProblems;Sourcesof agperformance;Fundamentalprincipleso msandfaultclearingissues;motor ationoftheeconomicsofdifferentalternativ	nsofpowerd fsag;swellan ofprotection ves.	ן uality asper IEEEst nd interruptions; Es ו; solutions at end us	
UNIT-II	TransientOver-Voltages Sourcesoftransientovervoltages;capacitorswitching;lightening;Ferroresonancesandother switchingtransients;Principlesofovervoltageprotections;devicesofovervoltageprotection s;Utilitycapacitorswitchingtransients;Utilitysystemlighteningprotection;managingFerrore sonance;switchingtransientsproblemswithloads;computertoolsfortransientanalysis.		sonancesandother voltageprotection n;managingFerrore isientanalysis.	[8Hrs]	
UNIT-III	FundamentalsofHa	armonics and its Analysis			[8Hrs]
	Introduction;theMa uencingtheDevelop es. IntroductiontoHarr omWaveformSymr rs;TheFourierTrans uistFrequencyandA WindowFunctions;	echanismofHarmonicGeneration;Definition omentofStandards,ExistingHarmonicStan nonicAnalysis;FourierSeriesandCoefficien netry;ComplexFormoftheFourierSeries;C form;SampledTimeFunctions;DiscreteFo Aliasing;FastFourierTransform(FFT); EfficiencyofFFTAlgorithms;AlternativeTransform	ionsandSta idards,Gene nts;Simplifi Convolution purierTransf ansforms.	ndards:FactorsInfl eralHarmonicIndic cationsResultingfr tofHarmonicPhaso form(DFT);TheNyq	
				_	
UNIT-IV	HarmonicSourcesa HarmonicSources: neHarmonics;Disto PhaseCurrent-Sour ControlledReactors HarmonicDistortion ffectofHarmonicso ;EffectofHarmonics Communications.	IndDistortions Introduction;TransformerMagnetization Introduction;TransformerMagnetization IntroducedbyArcingDevices;Single-Phase Introduction;Three-PhaseVoltage-Sources Introduction;Resonances;EffectsofHarr Introduction;Resonances;EffectsofHarr Introduction;Resonances;EffectsofHarr Interferences Introduction;Resonances;EffectsofHarr	Nonlineariti seRectificat ceConversio monicsonRo ewithPowe th	ies;RotatingMachi tion;Three- on;Thyristors- otatingMachines;E rSystemProtection	[8Hrs]
UNIT-V	Computation, Asse HarmonicComputa onicImpedancesfro bles; LoadModels; C HarmonicEliminatio ormanceCalculatio	ssmentandHarmonicElimination tion:Introduction;DirectHarmonicAnalys mFieldTests;TransmissionLineModels;U computerImplementation;ExamplesofAp on:Introduction;FilterDesignCriteria;Netw ns;TunedFilters;DampedFilters;Conventi	is;Derivatic nderground plicationoft workImped onalFilter	onofNetworkHarm JandSubmarineCa TheModels; anceforPerf	[8Hrs]

	Configurations;Band-PassFilteringforTwelve-PulseConverters;DistributionSystem				
FilterPlanning;FilterComponentProperties;D.C.SideFilters;ActiveFilter					
UNIT-\	/I Powerqualitymonitori	ng;Assessment&Mitigation	[8Hrs]		
	Needandapproachesfo	llowedinpowerqualitymonitoring;objectivesandrequirements;Initi			
	alsitesurvey;Powerqua	lityInstrumentation;Selectionofpowerqualitymonitors;monitoring			
	locationandperiod;Sele	ectionoftransducers;Harmonicmonitoring;Transientmonitoring;ev			
	entrecordingandflicker	monitoring.			
	PowerQualityassessme	ent;Powerqualityindices and standards for assessment; wave form dist			
	ortion;voltageandcurre	entunbalances; Powerassessment underwave form distortion conditi			
	ons.Powerqualitystate	estimation;Statevariablemodel;observabilityanalysis;capabilitieso			
	fharmonicstateestimat	ion;Testsystems;			
	Mitigationtechniquesa	tdifferentenvironments.			
Refere	nces:				
1.	Understandingpowerqualit	typroblems;voltagesagandinterruptions-			
	M.H.J.BollenIEEEpress;200	0;seriesonpowerengineering.			
2.	2. "POWERSYSTEMHARMONICS", SecondEditionByJosArrillagaandNevilleR.Watson; JohnWileyandPublic				
	ation,2003ISBN:0-470-85129-5.				
3.	Electricalpowersystemqual	lity-			
	PogeiC.Dugan;MarkF.McG	ranghan;Suryasantoso;H.WayneBeaty;secondedition;McGrawHillPu	ıb.		
4.	Powersystemqualityassess	ment-J.Arrillaga;M.R.Watson;S.Chan;JohnWileyandsons.			
5.	Electricpowerquality-G.J.H	eydt.			
6.	Powersystemharmonics:Co	omputermodelingandanalysis-			
	EnriquesAcha;ManuelMad	rigal;JohnwileyandsonsItd.			
7.	PowerSystemHarmonics–J.	Arrillaga&N.Watson			
8.	IEEEstd519-				
	1992/IEEEstd1159IEEEreco	mmendedpractices and requirements for harmonics controline lectric	alpowe		
	rsystem.		•		
9.	ECBCCode2007(Edition	n2008)publishedbyBureauofEnergyEfficiency;NewDelhiB	ureau		
	ofEnergyEfficiencyPubl	licationsRatingSystem;TERIPUBLICATIONSGRIHARatingSy	stem;L		
	EEDSPublications				
Syllabu	usforUnitTest:				
UnitTest-1		UNIT– I,UNIT–II,UNIT–III			
UnitTest-2		UNIT– IV,UNIT–V,UNIT–VI			

(Elective-II)AdvancedControl System				
TEACHINGSCHEME:		EXAMINATIONSCHEME:	CREDITSAL	LOTTED:
Theory:04Hours/Week		EndSemesterExamination:60Marks	03 Credits	
ContinuousAssessment:40Marks				
UNIT-I	PIDControl:			(08Hours)
	Review of c	lassical and modern control concepts:	PID control and	
	tuning approa	aches, Selection of Variables for Control	l, PID Controller	
	Tuning for D	ynamic Performance - Determining Tuni	ng Constants for	
	Tuning Con	stants Fine-Tuning the Controller Tu	Contentions for	
	Controller tu	ning based on stability – Dead beat and	self tuning Rate	
	feedback	ing cased on stating Dead coat and	sen taning, rate	
UNIT-II	StateVariabl	eAnalysis:		(08Hours)
	Control Syste	m Analysis Using State Variable Method	ls, Conversion of	
	transfer funct	ion tophase variable and canonical varial	ble model, Eigen	
	value and eigen vector, Kalman's test and Gilbert's Test for			
	controllabilityandobservabilityanalysisanddesignofcontrolsystemin state			
	space, Pole placement, State observer, Design of control system with			
	Luenberger observer			
UNIT-III	Nonlinearan	dRobustControl:	6 G 1 11	(08Hours)
	Nonlinear Sy	visitems and Equilibrium Points, Conce	pts of Stability,	
	Feedback I	inearization Input-output linearizati	on Input-State	
	Linearization			
	Concept of r	obust control, Description and categoriz	zation of system	
	uncertainties, System and signal norms, Small gain theorem, Robust			
	stability, Design of robust control, Introduction to H- ∞ control.			
UNIT-IV	Digital Cont	rol:		(08Hours)
	Structure of	the Digital Control System, ADC, I	DAC, Effects of	
	Sampling of	continuous time signals, Quantization, S	ample and hold,	
	Reconstruction of signal, Sampling Theorem, Aliasing, Elementary			
	discrete-time signals, Impulse response, Linear convolution and its			
properties, Z transform: Basics, Properties, Inverse Ztransform using				
z- plane with Jury's stability criteria				
	E production of the			(0011,0)
UNIT-V	FrequencyA	naiysis:		(U8Hours)

	Frequency response Bode plot, Bo Analysis(SFRA) Ideal filters and transfer functions Exponential represe continuous time s	se of first order and second order systems, Polar plot, ode plot from Sweep Frequency Response ftransformeranditsconclusion,Phaseandgroupdelays, theirpole zero locations,Zero phase andlinear phase sentation of Fourier series and Fourier transform of ignals, The Fourier series for discrete-Time periodic		
	signals(onlyconce signals (only co Periodicity, Line Linear convolution	pt), The Fourier transform of discrete-time aperiodic oncept), Discrete Fourier Transform, Properties: arity, Symmetry properties, Circular convolution, n using circular convolution Fast Fourier Transform;		
	Radix 2 DIT and I	DIF algorithms		
UNIT-VI	OptimalControl:		(08hours)	
	Parameter optimization and optimal control problems, Hamiltonian formulation of optimal control problem, Hamilton-Jacoby equation, Linear regulator problem, Quadratic performance criterion, Numerical solution of Matrix Riccati equation, Pontryagin's minimum principle, Application to optimal control of discrete and continuous systems (quadratic performance index, analysis and design offinite and infinite time), Linear Quadratic Regulators, Introduction to Linear Quadratic Gaussian approach			
TextBooks:				
1. Moder	nControlEngineerir	ng'-KatsuhikoOgata, PrenticeHall India,5thedition 2010	•	
2.'Non-li	nearSystems',byHa	ssanKhalil,PrenticeHall.		
3.Digital	Control–Ogata,Pren	ticeHall India		
	_			
ReferenceBo	ooks:			
1.DigtalC	Control-B.C.Kuo			
2. DigitalControlandStateVariableMethods'byM.Gopal,Tata-McGraw-HillPublishing Company Limited				
3.OptimalControl:LinearQuadraticMethods'BrianD.O.Anderson,JohnBarrattMoore, DoverPublications,2007				
SyllabustorUnitTest:				
UnitTest-1		UNIT-I,UNIT-II,UNIT-III		
Unit l'est-2		\cup INII-IV, \cup INII-V, \cup INII-VI		

(Elective–II)ADVANCEDPOWERELECTRONICSANDDRIVES					
TEACHING	ISCHEME:	EXAMINATIONSCHEME:	CREDITSALLO	TTED:	
Theory:04Hours/Week		EndSemesterExamination:60Marks	04Credits		
Practical:02Hours/Week		ContinuousAssessment:40Marks			
		TermWork:25Marks	01Credit		
UNIT-I	Converters:			(08Hours)	
	VoltageSourceConver	ters			
	Reviewof3-ph-				
	fullwavebridgeconver	ter,operationandharmonics,3levelvoltagesource	converters.P		
	WMconverter.Genera	lizedtechniqueofharmoniceliminationandvoltag	econtrol.Adv		
	ancedmodulationtech	niques(spacevectormodulation,3 rd harmonicPWl	M)Compariso		
	nofPWMtechniques.C	onverterrating Currentsourceconverters	1 It		
	(I) MatrixConverter:3	×3matrixconverter,principleofworking,mathema	iticaltreatme		
	(ii) SelfandLinecomm	xconverter with multipulse converter	SC converter		
	swithselfcommutating	adevices	.sc,converter		
UNIT-II	Swithselicommutatingdevices			(08Hours)	
	Multilevelconcept.Tvr	esofmultilevelInverters.diodeclampedmultileve	linverter.flvin	(
	g-				
	capacitorsmultilevelinverters,cascadedmultilevelinverter,switchingdevicecurrents,				
	D.C.linkcapacitorvoltagebalancing, features of multilevelinverters, comparison of mult				
	ilevelinverters.Applicationsofmultilevel				
	Inverter:ReactivepowercompensationBacktobackintertiesystem				
UNIT-III	DCDrives:			(08Hours)	
	Singlephaseand3phas	econverterdrives.FourquadrantChopperdrives,c	osedloopcont		
	rolofDCmotor,Permar	nentmagnetDCmotordrives,DCServodrives,			
	applications				
UNIT-IV	InductionMotorDrive	S:		(08Hours)	
	3phaseinductionmoto	rcontrol, statorvoltage control/rotorvoltage control	ol,volta		
	geandfrequencycontr	ol, current control, closed loop control of 3-			
	phaseinductionmotor	.Softstarters, comparison of variable frequency driv	ves,Spee		
	d		-		
	controlbystaticslippowerrecovery induction motorservodrives applications				
UNIT-V	SynchronousMotorD	ives:		(08Hours)	
	Voltageandfrequency	control, closed loop control of synchronous motors.	Synchronous	· · ·	
	motorservodrivewiths	inusoidalwaveform, synchronous motors ervodriv	vewithtrapezoi		
	dalwaveform.Loadcor	nmutated invertor drives.speed	·		
	controlofsynchronousmotorsbycyclo-convertors applications				
UNIT-VI	Akagi'sp-atheory			(08Hours)	

	Conventionalconceptsofactiveandreactivepowerinsinglephaseandthreephasecircui				
	$ts-Equation of power with sinusoidal voltages our ceand non-linear loads-\alpha\beta o$				
	transformationofthreephasefourwiresystem-Akagi's instantaneous				
	power(pq)theory-relationship between Akagi's components and conventional				
	activeandreactivepowerapplicationofpqtheorytoreactiveandharmonicpowercompe				
	nsationinsimplecircuits		1		
			l I		
Text Book	s:				
1.BimalKB	ose,Modernpowerelectro	onicsand ACdrives, Pearsoned ucation asia			
2.G.K.Dub	ey,FundamentalsofElectr	ical Drives CRC press 2002			
3.VedamS	ubrahmanyamElectricDri	ves:Concepts&ApplTataMcGraw-Hill			
4.Powerel	ectronicsconvertors,appl	icationsanddesign,NedMohan,ToreMUndeland,WilliamP			
Robbii	ns,WileyIndiaPvt.Ltd.,200	9			
5 E.Acha	, Miller & Others, Power El	ectronicControlinElectricalSystems(Newnes,Oxfordpublication)—		
firstEd	firstEdition				
6 M.H.RashidPowerElectronics,PrenticeHallofIndiaPvt.Ltd.NewDelhi,(3rdEdition)					
7. RKrishnan, Electric motor drives, modeling, analysis and control, PHI learning Pvt. ltd. 2001					
8.S.K.Pillai	,Afirstcourseinelectricald	rives, Newage international publishers. 2010			
Reference	Book and Papers:				
1.E.H.	Watanube, R.M. Stephena	IndMauricoArdes"NewConceptsofinstantaneousactiveand			
re	activepowersinElectricals	systems with Generic loads" (IEEE transaction on Power Delivery Vo)1.8,		
	0.2April1993, PP-697-703	alemnia "A comparisonal valtage courseand current courses	hunt		
Z.L.Be	nundild,S.SduddlednuA.S	deminia – A comparisonor voltage sourceand current source s			
M	Activements/simulationandexperimentation (TEEETransactiononPowerSystems, vol14, No.2, May 99. PP642-647				
3. H	3. H.Akagi, E.H.WatanabeandM.Aredes"InstantaneousPowerTheorvandApplicationstoPower				
Co	Conditioning,IEEEPress,NewYork				
Syllabusfo	rUnitTest:				
UnitTest-1		UNIT– I,UNIT–II,UNIT-III			
UnitTest-2		UNIT– IV,UNIT–V,UNIT-VI			