SEMESTER III

	3301	ELECTRICAL POWER DISTRIBUTION SYSTEM	3	0	0	3
COU	RSE (OBJECTIVES				
To en	able th	ne students to				Ī
1	infer	r the size of feeders and distributors based on economy and efficiency.				
2	inter	rpret the concepts of distribution system control and protection.				
3	cons	strue the reliable design consideration.				
4	unde	erstand the requirements of automation system.				
5	com	prehend the network configuration and planning of distribution system.				
UNIT	I	DISTRIBUTION SYSTEMS	111 150	-77.11		9
Distri	bution	systems - Types of distribution systems, section and size of feeders, pr	imary	and se	econda	ary
distrib	oution,	, distribution substations; Effect of working voltage on the size of feed	lers an	d dist	ributo	rs;
Effect	t of sys	stem voltage on economy; Voltage drop and efficiency of transmission; (Qualita	tive t	reatme	ent
		ribution and industrial distribution.	Z	-016	·	
UNIT		CONTROL AND PROTECTION		TO DO SALE	0	9
		stral Application of about conscitouse for loss and sation because in	41			42.
		ntrol - Application of shunt capacitance for loss reduction, harmonics				
		ntrol - Application of shunt capacitance for loss reduction, harmonics in ns; Voltage profile enhancement schemes; System protection - Fuses ar				
VAR	systen		nd sect	ion ar	nalyze	rs;
VAR Over	systen	ns; Voltage profile enhancement schemes; System protection - Fuses ar	nd sect	ion ar	nalyze	rs;
VAR Over device	systen curren	ns; Voltage profile enhancement schemes; System protection - Fuses ar	nd sect	ion ar	nalyze	ers;
VAR Over device	systen curren e.	ns; Voltage profile enhancement schemes; System protection - Fuses are protection; Under voltage and under frequency protection; Coordi	nd sect	of p	nalyze	ers; ive
VAR Over device UNIT Prima	system current e.	ns; Voltage profile enhancement schemes; System protection - Fuses are not protection; Under voltage and under frequency protection; Coordinate RELIABILITY ANALYSIS	nation ions, p	of programmer	rotect	ers; ive
VAR Over device UNIT Prima	system current e. TIII ry and	ns; Voltage profile enhancement schemes; System protection - Fuses are not protection; Under voltage and under frequency protection; Coordinate Protection; Under voltage and under frequency protection; Coordinate Protection; Coor	nation ions, p	of programmer	rotect	ers; ive
VAR Over device UNIT Prima loadin	system current e. 'III ry and ng, second	RELIABILITY ANALYSIS d secondary system design considerations - Primary circuit configuration ondary networks design; Economic design; Unbalance loads and voltage	ions, p	of portion	rotections.	ers; ive 9 der
VAR Over device UNIT Prima loadin UNIT Defini	system current e. 'III rry and ing, second IV	RELIABILITY ANALYSIS d secondary system design considerations - Primary circuit configuration ondary networks design; Economic design; Unbalance loads and voltage DISTRIBUTION AUTOMATION Automation switching control; Management information systems (MISTRIBUTION Systems (MISTRIBUTION Systems)	ions, pe cons	of province of pro	y feed	9 der
VAR Over device UNIT Prima loadin UNIT Defini units	system curren e. TIII rry and ng, secon TIV itions; — Con	RELIABILITY ANALYSIS discondary system design considerations - Primary circuit configuration ondary networks design; Economic design; Unbalance loads and voltage DISTRIBUTION AUTOMATION Automation switching control; Management information systems (MISTRIBUTION methods for data transfer; Consumer information services and the protection of the protecti	ions, pe cons	of profession are of professio	y feedions.	9 der
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VAR Over device UNIT Prima loadin UNIT Defini units inform Substa side at UNIT Distril transm - Distri	system curren e. TII ry and ng, secon IV itions; — Con nation a utomat V bution nission ributio haract	RELIABILITY ANALYSIS d secondary system design considerations - Primary circuit configuration ondary networks design; Economic design; Unbalance loads and voltage DISTRIBUTION AUTOMATION Automation switching control; Management information systems (MISTRIBUTION AUTOMATION) Automation methods for data transfer; Consumer information service systems (GIS); Automatic meter reading (AMR); Remote control automation — Requirements, control aspects in substations; Feeder automation. EXPANSION PLANNING a system planning - Short term planning, long term planning, dynamic and substation design; Sub-transmission networks configurations - Substations ratings, service areas calculations; Distribution system expansion of the substation of the system of the substation of the system planning is substation of the substation of the system planning.	ions, pe cons S); Re ce (CI load omation	of province of pro	y feed ions. terminageme onsum	9 der 9 nal cal nt; ner 9

At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	describe about the size of feeders under economic in electric power distribution system.	Understanding (K2)
CO2	enumerate control and protection schemes for distribution systems.	Applying (K3)
CO3	Explain the reliability of distribution systems.	Understanding (K2)
CO4	demonstrate the methodologies for distribution automation.	Understanding (K2)
CO5	develop strategies for network configuration by expanding the existing distribution systems.	Understanding (K2)

- C.L. Wadhwa, "Electrical Power Systems", New Age International Publishers, Sixth Edition, 2019.
- A.S. Pabla, "Electrical Power Distribution Systems", Tata McGraw Hill Books Company, Sixth Edition, 2017.
- V. Kamaraju, "Electrical Power Distribution Systems", Tata McGraw Hill Books Company, Sixth Edition, 2019.
- James A Momoh, "Electric Power Distribution Automation Protection and Control" CRC Press, 2017.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's

			utcomes PO's			
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	3	3	2	2
CO2	3	2	3	3	2	-
CO3	3	2	3	3	-	2
CO4	3	2	3	3	2	2
CO5	3	2	3	3	2	2



PPS2	23302	PROJECT WORK (PHASE I)	0	0	12	6
COU	RSE OBJECTIVES	in the second of contradering 3-Strong, I-blind				
To en	nable the students to	Or manufacture (
1	identify a specific pro	blem as per current need of the society.	1.00		- 0	7
2	carry out literature rev	views related to their identified problems.				
3	analyse the methodolo	ogy to solve the identified problems.		П		
4	acquire knowledge or required.	n desire results based on the methodology used	and model	har	dwar	e if

DESCRIPTION

Each PG student can work individually on a selected specific topic in the area which is approved by the head of the department under the supervision of a faculty member (Guide / Supervisor) who is familiar in the selected specific topic. The selected specific topic may be hardware or simulation. The students project work (phase I) shall be evaluated through internal examination and end semester examination. The internal examination must be conducted periodically (zeroth, first, second and third) through project work review presentation meetings followed by questions from the panel of review committee members comprising of two expert faculty members and a project coordinator. At the end of the semester, a detailed report on the work done by the PG student must be submitted with the approval from the Guide/Supervisor and the review committee members. The project work (phase I) report must contain the introduction with clear definition along with detailed review of relevant literature on the selected specific problem; an efficient methodology to solve the selected specific problem along with necessary hypothesis and or experimental setup and or simulation and or case study for carrying out the research project work along with preliminary results; discussions, relevant conclusions and future direction along with specified references. The end Semester examination must be conducted through project work presentation followed by questions from the panel of examiners comprising an external examiner and project coordinator as internal examiner.

	7.0	TOTAL PERIODS 180
COU	RSE OUTCOMES	
At the	end this course, students will be able to	BT Mapped (Highest Level)
CO1	demonstrate a sound technical knowledge in their selected project topic.	Analyzing(K4)
CO2	select and identify the problem statement along with scope and boundary;	Analyzing(K4)
CO3	assimilate detailed review of relevant literature; formulate an efficient methodology to solve the selected specific problem.	Analyzing(K4)
CO4	propose solutions to complex problems by professional approach.	Analyzing(K4)

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme O	utcomes PO's	- de etenter r	off side
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3



PPS23401			PROJECT WORK (PHASE II)			24	12
COU	RSE OBJECT	IVES					
To en	able the student	s to	distribution of the land and the land	THE STATE			
1	identify a spe	cific probler	n as per current need of the society.				
2	carry out liter	ature review	vs related to their identified problems.	1.07			
3	analyse the m	ethodology	to solve the identified problems.				
4	acquire know required.	ledge on de	esire results based on the methodology used a	and model	har	dwar	e if

DESCRIPTION

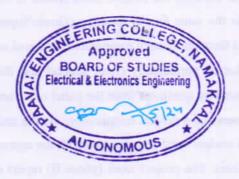
The student may continue to work on the project work (phase I) selected topic as per the formulated efficient methodology under the same faculty member (Guide/Supervisor). The students project work (phase II) shall be evaluated through internal examination and end semester examination. The internal examination must be conducted periodically (first, second and third) through project work review presentation meetings followed by questions from the panel of review committee members comprising of two expert faculty members and a project coordinator. At the end of the semester, a detailed report on the work done by the PG student must be submitted with the approval from the Guide/Supervisor and the review committee members. The project work (phase II) report must contain the introduction with clear definition along with detailed review of relevant literature on the selected specific problem; an efficient methodology to solve the selected specific problem along with necessary theoretical hypothesis and or experimentation and or simulation and or case study for carrying out the research project work along with complete results with critical analysis and detail discussions, followed by relevant conclusions, along with specified references. The end semester examination must be conducted through project work presentation followed by questions from the panel of examiners comprising an external examiner and project coordinator as internal examiner.

		TOTAL PERIODS 360
COUL	RSE OUTCOMES	
At the	end this course, students will be able to	BT Mapped (Highest Level)
CO1	demonstrate a sound technical knowledge of their selected project topic	Analyzing
CO2	propose solutions to complex problems using a systematic approach.	Analyzing
CO3	compare hardware results for the proposed methodology by technical knowledge.	Analyzing
CO4	demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of power systems engineering and find optimum solutions to it.	Analyzing

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme O	utcomes PO's	ing calculate to	Air I fi
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	2	1	3	3	3	3
CO2	3	2	3	3	3	3
CO3	3	2	3	3	3	3
CO4	3	2	3	3	3	3



PROFESSIONAL ELECTIVES

PPS2	23151	Al	NALYSIS OF POWER CONVERTERS 3 0 0	
COU	RSE C	BJECTIVES		DI.
To er	nable th	e students to	Commission of the Commission of the State of the Commission of the	-111
1	analy		nend the various operating modes of different configurations of po	ower
2	knov	the operation of	various inverter and their PWM controlling techniques.	EET
3	desig	gn different power	r converters DC to DC converters.	
4	learn	the types of AC	voltage controllers and basics of matrix converters.	
5	impa	rt knowledge on	different types of multilevel inverter and PWM techniques.	
UNIT	ГІ	CONVERTER	RS *	9
pulse	conver	ter.		
puise	conver	ter.		
PWM	iple of 1 techn	7	and full bridge inverters; Voltage control of single phase inverters to elimination techniques; 180 degree and 120 degree conduction ronnected loads.	ising
Princ PWN invert UNIT Princ conve	iple of I techn ters with I III ciples of erters;	operation of half iques; Harmonic h star and delta co	elimination techniques; 180 degree and 120 degree conduction ronnected loads.	node 9 cuk
Princ PWM invert UNIT Princ conve	techn ters with terms with	operation of half iques; Harmonic th star and delta control DC-DC CONV of step-down and control ratio and control of the star and delta control of the	d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-resonant and quasi-r	9 cuk
Princ PWN invert UNIT Princ conve conve	riple of technoters with rill ciples of erters; retrers.	operation of half iques; Harmonic th star and delta control DC-DC CONV of step-down and Cime ratio and control AC VOLTAGE	c elimination techniques; 180 degree and 120 degree conduction reconnected loads. VERTERS d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-reso	9 cuk
Princ PWM invert UNIT Princ conve UNIT Princ Princ	riple of techn ters wit rill ciples of erters; erters. riv ciple of	operation of half iques; Harmonic th star and delta control by the star and delta control by the star and delta control; Si and control; Si operation of half iques; Harmonic the star and delta control; Si operation of half iques; Harmonic the star and delta control is a control; Si operation of half iques; Harmonic the star and delta control is a control; Si operation of half iques; Harmonic the star and delta control is a control in the star and delta control in the star and delt	d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-resonant and quasi-r	9 cuk
Princ PWM invert UNIT Princ conve UNIT Princ Princ	riple of technoters with ters of the ters.	operation of half iques; Harmonic h star and delta control of step-down and control of the ratio and control operation single	elimination techniques; 180 degree and 120 degree conduction reconnected loads. /ERTERS d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-reso	99 cuk
Princ Pww invert UNIT Princ conve UNIT Princ Princ Conve UNIT Multi multi	r IV ciple of certers. T IV ciple of certers. T V ciple of certers.	operation of half iques; Harmonic th star and delta co DC-DC CONV of step-down and Time ratio and co AC VOLTAGI phase control; Si operation single MULTILEVE oncept – Diode co inverters; Ap	relimination techniques; 180 degree and 120 degree conduction reconnected loads. VERTERS d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-resonant and quasi-resonant and three phase controllers — Analysis with R and R-L leads and three phase cyclo-converters; Power factor control; Management of the phase and three phase cyclo-converters; Power factor control; Management of the phase and three phase cyclo-converters; Power factor control; Management of the phase cyclo-converters; Power factor control; Power f	99 cuk onant
Princ Pww invert UNIT Princ conve UNIT Princ Princ Conve UNIT Multi multi	r IV ciple of certers. T IV ciple of certers. T V ciple of certers.	operation of half iques; Harmonic th star and delta co DC-DC CONV of step-down and Time ratio and co AC VOLTAGI phase control; Si operation single MULTILEVE oncept – Diode co inverters; Ap	elimination techniques; 180 degree and 120 degree conduction reconnected loads. /ERTERS d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-resonant and three phase controllers — Analysis with R and R-L least phase and three phase cyclo-converters; Power factor control; Managed, flying capacitor, cascade type multilevel inverters, comparison polication of multilevel inverters; PWM techniques	9 cuk onant 9 gon of for
Princ PWM invert UNIT Princ conve UNIT Princ Conve UNIT Multi multi multi	riple of technoters with ters of the ters. TIV tiple of terters. TV tiple of terters. TV tiple of terters.	operation of half iques; Harmonic th star and delta co DC-DC CONV of step-down and Time ratio and co AC VOLTAGI phase control; Si operation single MULTILEVE oncept – Diode co inverters; Ap	d step-up converters; Analysis of buck, boost, buck-boost and urrent limit control; Full bridge converter; Resonant and quasi-resonate phase and three phase controllers — Analysis with R and R-L less phase and three phase cyclo-converters; Power factor control; Managed, flying capacitor, cascade type multilevel inverters, comparisonate and three phase impedance source inverters.	9 cuk onant 9 garatrix

CO1	apply the different converter configuration based on the	Applying (K3)
	application.	
CO2	describe the single and three phase inverter.	Understanding (K2)
CO3	design a suitable DC-DC converter for given load specification.	Analyzing(K4)
CO4	apply different types AC voltage controller based on the application.	Applying (K3)
CO5	analyze the multilevel inverter for power system application.	Analyzing(K4)

- Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2014.
- Bimal K.Bose, "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2013.
- Ned Mohan, T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and design" John Wiley and sons, Wiley India Edition, 2016.
- 4. P.S.Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2013.
- Power Electronics by Vedam Subramanyam, New Age International publishers, New Delhi Second Edition, 2016.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

		nes laties	Programme Ou	tcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	3	3
CO2	2	2	2	2	3	3
CO3	3	3	2	2	3	3
CO4	2	2	3	1	3	3
CO5	3	3	2	1 000	3	3



PPS	23152		SYSTEM THEORY 3 0	0
cot	JRSE O	BJECTIVES		
Тое	nable th	e students to		
1	train	on modeling and	1 representing systems in state variable form.	
2	educ	ate to solve linear	r and non-linear state equations.	
3	illust	trate the propertie	es of control system.	
4	ident	tify non-linearitie	es and examine stability of systems in the sense of Lyapunov's the	ory.
5	educa	ate on modal con	cepts, design of state, output feedback controllers and estimators.	
UNI	TI	STATE VARI	ABLE REPRESENTATION	
Conc	cept of s	state-space equati	ions for dynamic systems -Time invariance and linearity, non-uni	quenes
of sta	ate mode	el; Physical syste	ems and state assignment - Free and forced responses; State diagram	ns.
UNI	TII	SOLUTION O	OF STATE EQUATIONS	
linon	- time .	verning state on	untiana, Stata transition matrix and its proportion Fundantian of	
expo		System modes, re	uations; State transition matrix and its properties; Evaluation of ole of eigen values and eigen vectors. S OF THE CONTROL SYSTEM	
UNI Cont	nential- T III rollabili	PROPERTIES ity and observabil	ole of eigen values and eigen vectors.	
UNI Cont varyi	T III rollabili ing and	PROPERTIES ity and observabilitime invariant car NON-LINEAR	ole of eigen values and eigen vectors. S OF THE CONTROL SYSTEM lity, stabilizability and detectability, test for continuous time systemse, output controllability; Reducibility-System realizations. RITIES AND STABILITY ANALYSIS	ns, time
UNI Cont varyi UNI Equi of no Desc conti autor	T III rollabiliting and rollibrium onlineariting in the ribing of the rolling and rolling	PROPERTIES ity and observability and observability in a care NON-LINEAR points-Stability is ity — Phase plane function method, time autonomous	S OF THE CONTROL SYSTEM lity, stabilizability and detectability, test for continuous time systemse, output controllability; Reducibility-System realizations. RITIES AND STABILITY ANALYSIS in the sense of Lyapunov, BIBO stability, stability of LTI systemse analysis, singular points, limit cycles; Construction of phase traject, derivation of describing functions; Equilibrium stability of news systems - Direct method of Lyapunov and the linear continuous unov Functions for nonlinear continuous time autonomous stability.	rs, time
UNIT Contivaryi UNIT Equi of no Desc conti	T III rollabiliting and rollibrium onlineariting in the ribing of the rollibrium of the ribing of the rollibrium on the ribing of the ribing o	PROPERTIES ity and observability and observability in invariant car NON-LINEAR points-Stability is ity — Phase plane function method, time autonomous systems, Lyapu	S OF THE CONTROL SYSTEM lity, stabilizability and detectability, test for continuous time systemse, output controllability; Reducibility-System realizations. RITIES AND STABILITY ANALYSIS in the sense of Lyapunov, BIBO stability, stability of LTI systemse analysis, singular points, limit cycles; Construction of phase traject, derivation of describing functions; Equilibrium stability of news systems - Direct method of Lyapunov and the linear continuous unov Functions for nonlinear continuous time autonomous stant method.	rs, time
UNI Cont varyi UNI Equi of no Desc conti autor Kras UNI Cont	T III rollabiliting and rollab	PROPERTIES ity and observability and observability and observability in time invariant can be points-Stability in tity — Phase plane function method, time autonomous systems, Lyapund variable-gradient with the points of the po	S OF THE CONTROL SYSTEM lity, stabilizability and detectability, test for continuous time system see, output controllability; Reducibility-System realizations. RITIES AND STABILITY ANALYSIS in the sense of Lyapunov, BIBO stability, stability of LTI systems analysis, singular points, limit cycles; Construction of phase traject, derivation of describing functions; Equilibrium stability of news systems - Direct method of Lyapunov and the linear continuous unov Functions for nonlinear continuous time autonomous siant method. ALYSIS companion forms - SISO and MIMO systems, effect of state feed lity, pole placement by state feedback for both SISO and MIMO s	rs, time

COUR	SE OUTCOMES	Pitrow
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
C01	understand the concept of state-state representation for dynamic systems.	Applying (K3)
CO2	explain the solution techniques of state equations.	Understanding (K2)
CO3	realize the properties of control systems in state space form.	Analyzing(K4)
CO4	identify non-linearities and evaluate the stability of the system using lyapnov notion.	Analyzing(K4)
CO5	perform modal analysis and design controller and observer in state space form.	Analyzing(K4)

- M. Gopal, "Modern Control System Theory", New Age International, Third Edition, Reprint 2015.
- 2. Z. Bubnicki, "Modern Control Theory", Springer, 2018.
- 3. K. Ogatta, "Modern Control Engineering", PHI, 2017.
- 4. D. Roy Choudhury, "Modern Control Systems", New Age International, 2015.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme O	utcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	3	3
CO2	3	3	2	2 '	3	3
CO3	3	3	2	2	3	3
CO4	3	3	3	1	-	3
CO5	3	3	2	1	3	3



	3153	Very BIV	POW	ER SYS	TEM R	ELIAB	ILITY			3	0	0	3
COU	RSE O	BJECTIVES											
To ena	able the	e students to	9.10	N. C. C. C.						HE/ell			
1	know	the basic conce	epts of	eliability	enginee	ering.							
2	under	stand about the	probab	ility meth	nods in g	generatii	ng capa	city.					
3	know	the concept of f	frequer	cy and du	uration 1	methods	in gene	erating o	apacity				5
4	study	the formation o	of syste	m model.	-								
5	learn	the importance ol.	of relia	bility ind	lices in p	power sy	ystem p	lanning	, expans	sion,	opera	ation	and
UNIT	I	INTRODUCT	TION				•						9
		system security: n reliability asset			analysis;	Linear	sensiti	vity fac	tors, hie	erarcl	hical	level	s ir
	. Jane	GENERATIN	NG CA	PACITY	() TO () TO (22.3.50		ALSO D	iivale	nt for	
Gener outage	ation s	GENERATIN ystem models – capacity expansi	NG CA	PACITY ty outage	probabi	ility tabl	es, loss	of load	indices	, equ			rced
Gener outage of ene	ration s e rate, o	GENERATIN ystem models – capacity expansi	vG CA capaci	PACITY ty outage lysis, sch	probabi eduled o	ility tabl outages,	es, loss evalua	of load	indices	, equ	iod b	asis,	
Gener outage of ene UNIT Introd	ration s e rate, o ergy inc	GENERATIN ystem models – capacity expansi lices.	or CA capaci ion ana NG CA model	PACITY ty outage lysis, sche	probabilities probabilities and additional probabilities and additinational probabilities and additional probabilities and additiona	ility tabloutages,	es, loss evalua	of load	indices	, equ	iod b	asis,	loss
outage of ene UNIT Introd	ration s e rate, o ergy inc	GENERATIN ystem models – capacity expansi lices. GENERATIN – Generation in	vG CA capaci ion ana vG CA model tical sy	PACITY ty outage lysis, sche PACITY with no o	probabilities.	outages, QUENC states,	es, loss evalua Y AND system	of load tion me DURA	thods of	ME7	iod b	asis,	loss 9 and
Generoutage of ene UNIT Introd cumul UNIT Introd	ration see rate, or r	GENERATIN ystem models – capacity expansi lices. GENERATIN Generation in oad model; Pract	NG CA capaci ion ana NG CA model tical sy E GEN guration point	PACITY ty outage lysis, scho PACITY with no outage stem stud ERATIO indices; A	reduled of the second of the s	QUENC states, TRAN	es, loss evalua Y AND system 	of load tion me DURA risk inc	indices thods on TION dices w	MET with it	rHO ndivi	D dual	loss 9 and
General outage of ene UNIT Introdumul UNIT Introdumul selection components of the co	ration see rate, or r	GENERATIN ystem models – capacity expansi lices. GENERATIN Generation in oad model; Pract COMPOSITE Radial configuration and load	NG CA capaci ion ana NG CA model tical sy E GEN guration point evalua	PACITY by outage lysis, school PACITY with no of stem stud ERATIO s, conditi indices; A	reduled of the second of the s	QUENC states, TRAN	es, loss evalua Y AND system 	of load tion me DURA risk inc	indices thods on TION dices w	MET with it	rHO ndivi	D dual	9 and
General outage of ene UNIT Introd cumul UNIT Introd selection compound UNIT Introd oriente oriente outage of ene UNIT Introd oriente outage outage of ene UNIT Introd oriente outage outage of ene UNIT Introd oriente outage outage of ene UNIT Introd oriente outage outage outage of ene UNIT Introd oriente outage ou	ration see rate, or rate of the rate of th	GENERATIN ystem models – capacity expansi lices. GENERATIN – Generation in oad model; Pract COMPOSITE – Radial configuration and load estem reliability of	acapacition analogo CA model tical sy E GEN guration point evaluation technication sy	PACITY ty outage lysis, school PACITY with no outside stem stude ERATIO s, condition indices; Action. (STEM tues; Intervisems —	robability in the probability of	QUENC states, TRAN tobability tion to	Y AND system System res: cust es: cust	of load tion me	TION dices w VSTEM work com; Data	MET vith i	rHO ndivi	dual dual	9 and 9 state for 9

6.0	1 (2)	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	acquire design knowledge of system components in reliability point of view.	Understanding (K2)
CO2	understand the importance of customer oriented and system oriented indices.	Understanding (K2)
CO3	illustrate the concept of frequency and duration methods in generating capacity.	Understanding (K2)
CO4	familiarize with reliability evaluation methodologies.	Understanding (K2)
CO5	analyse the system performance with proper remedial strategies.	Analyzing(K4)

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CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	DOMESTIC NO.	TANK BULLAND	Programme Ou	tcomes PO's		3 11
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2 *	3	3
CO2	3	3	2	2	3	3
CO3	3	3	2	2	3	3
CO4	3	3	3	1	3	3
CO5	3	3	2	1	3	3



PPS2	3154		DESIGN OF SUBSTATION	3	0	0	3
COU	RSE	OBJECTIVES	and a local participation in abusin				
To en	able t	the students to	minimo Latrajo des galdenario sedenata)	Man		14	10
1	gati	her knowledge abo	out air insulated (AI) and gas insulated (GI) substations.				1
2	awa	are of substation e	quipment and their arrangements.	T last	ME		9
3	-		ots of insulation coordination and standards of substation	1.	i ui	T	
4			n grounding system and shielding.	J. Jane	ER	1	×
5	kno	w about the source	e and effect of fast transients in air insulated, gas insulate	ed subst	ation	S.	
UNIT	I	INTRODUCTI	ON			I	9
insulat	ted lin		ostations; Environmental considerations, planning and ated busducts (GIB).	d instal	lation	n; G	as
UNIT	II	MALTON BOLL					
mecha main l	nical bus a	pment of AIS and aspects of substat	PMENT AND LAYOUT GIS - Design features, equipment specification, types of ion design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus.	circuits	- Sir	igle	es,
mecha main l transfe	bus a er bus	aspects of substate and sectionalized breaker and half	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus.	circuits main, r	- Sir	ngle re an	es, or nd
mecha main l transfe UNIT Introdu its sele	bus a er bus. III	aspects of substate and sectionalized breaker and half INSULATION (and to insulation cook	GIS - Design features, equipment specification, types of ion design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus- scheme, ring bus.	main, r	- Sir	ngle re an	or nd 9
mecha main I transfe UNIT Introdu its sele	bus a er bus. III uction ection and IE	aspects of substate and sectionalized breaker and half INSULATION (a) to insulation cool, standard basic in EC guides.	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION rdination of AIS and GIS – Stress at the equipment, insu	main, r	- Sir	ngle re an	es, or nd
main la transfe UNIT Introdu its sele EEE a UNIT Definit	bus a er bus. III uction ection and IE IV	aspects of substate and sectionalized breaker and half INSULATION of to insulation cools, standard basic in the cools of	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION rdination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method;	main, r	treng	th ar	es, or nd 9 nd th
mecha main la transfe UNIT Introdu tts sele EEE a UNIT Definit	bus a er bus. III uction ection and IE IV tions ion g	aspects of substate and sectionalized and sectionalized preaker and half insulation coom, standard basic in a gradual coordinate and the section of the sect	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION rdination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method; AND SHIELDING we measurement, ground fault currents, ground conditions.	main, r	treng	th ar	es, or nd 9 nd th
mecha main l transfe UNIT Introdu ts sele EEE a UNIT Definit	bus a er bus. III uction and IE IV tions ion gr	aspects of substate and sectionalized and sectionalized breaker and half insulation coom, standard basic in a grounding system - FAST TRANSIF	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION Idination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method; AND SHIELDING I measurement, ground fault currents, ground conductions of substations, shielding by wires and masts. ENTS PHENOMENON IN AIS AND GIS	circuits main, r	treng arisor	ngle and the art will be a simple and the art	es, or and 9 and th
mecha main l transfe UNIT Introdu its sele EEE a UNIT Definit substat UNIT	bus a er bus. III uction ection and IE ions ion gr	aspects of substate and sectionalized and sectionalized breaker and half insulation cools, standard basic in the insulation co	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION rdination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method; AND SHIELDING y measurement, ground fault currents, ground conductions of substations, shielding by wires and masts.	circuits main, r	treng arisor	ngle and the art will be a simple and the art	es, or and 9 and th 9 of 9
mecha main l transfe UNIT Introdu its sele EEE a UNIT Definit substat UNIT ntrodu propaga	tions action action	aspects of substate and sectionalized and sectionalized breaker and half insulation cools, standard basic in a gradual sectional section for the insulation cools, standard basic in a gradual section for the insulation cools, standard basic in a gradual section for the insulation cools, standard basic in a gradual section for the insulation for the insul	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION Idination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method; AND SHIELDING I measurement, ground fault currents, ground conductions of substations, shielding by wires and masts. ENTS PHENOMENON IN AIS AND GIS witching in relation to very fast transients overvoltage	circuits main, r llation s ; Compa	treng arisor	ngle and the arm will be a second to the arm will be a sec	es, or nd 9 nd th 9
mecha main la transfe UNIT Introdu its sele EEE a UNIT Definit substat UNIT Introdu propaga	r bus. III uction and IE IV tions ion graction ation	aspects of substate and sectionalized breaker and half INSULATION of to insulation cools, standard basic in EC guides. GROUNDING A Soil resistivity rounding system - FAST TRANSIF A Disconnector stand mechanism of DUTCOMES	GIS - Design features, equipment specification, types of fon design, substation switching schemes; Single feeder single bus, double main bus-main and transfer bus-scheme, ring bus. COORDINATION Idination of AIS and GIS – Stress at the equipment, insumpulse level (BIL); Application of simplified method; AND SHIELDING I measurement, ground fault currents, ground conductions of substations, shielding by wires and masts. ENTS PHENOMENON IN AIS AND GIS witching in relation to very fast transients overvoltage. EVFTO, VFTO characteristics, effects of VFTO.	circuits main, r llation s ; Compa	treng arisor	ngle and the arm will be a second to the arm will be a sec	es, or nd 9 nd th 9 of 9 D,

CO1	express the fundamentals of air insulated (AI) and gas insulated (GI) substations.	Understanding (K2)
CO2	describe the assembly of substation equipment's.	Understanding (K2)
CO3	deliver standards of insulation coordination.	Understanding (K2)
CO4	design the substation grounding system and shielding.	Analyzing(K4)
CO5	implement the effects of fast transients in AIS and GIS.	Analyzing(K4)

- 1. Andrew R. Hileman, "Insulation Coordination for Power Systems", Taylor and Francis, 2015.
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- Pritindra Chowdhuri, "Electromagnetic Transients in Power Systems", PHI Learning Private Limited, New Delhi, Second edition, 2014.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

		شمسير الأبراد	Programme O	utcomes PO's	مرومة أنسطينا	
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2		of an el
CO2	3	3	2	2	****	
CO3	3	3	2	2	3	3
CO4	3	3	3	1	3	3
CO5	3	3	2	1	3	3



PPS2	3155	ANALYSIS OF ELECTRICAL MACHINES	3 0	0	3
cou	RSE O	BJECTIVES			
To en	able the	e students to			
1	provi	de knowledge about the fundamentals of magnetic circuits.			
2	recog	gnize the steady state and dynamic state operation of DC machine.			
3	impa	rt knowledge on theory of transformation of three phase variables to two p	nase v	ariabl	es.
4		ze the steady state operation of three-phase induction machines using y based mathematical modeling.	g trans	form	ation
5		iarize on steady state and dynamic state operation of three-phase synchic transformation theory based mathematical modeling.	onous	macl	nines
UNIT	I	ELECTROMAGNETIC ENERGY CONVERSION			9
energ	y conv	ersion - Energy relationships, energy in coupling fields; Machine wind ive force; Winding inductance and voltage equations.			
UNIT	П	DIRECT- CURRENT MACHINES			9
		onnected dc machine; Dynamic characteristics of permanent magnet and some block diagrams and state equations.	hunt 1	OC m	otor
UNIT	Ш	REFERENCE FRAME THEORY	-0-1	GIF	
Equat	ions of				9
frame	s; Tran	transformation - Changes of variables; Stationary circuit variables transformation - Changes of variables; Stationary circuit variables transformation be reference frames; Transformation be sformation of a balanced set; Balanced steady state phasor relationships; equations.	ween	refer	the
frame state v	s; Tran voltage	ference frame; Commonly used reference frames; Transformation be sformation of a balanced set; Balanced steady state phasor relationships;	ween	refer	the
state v UNIT Voltage transfe equation	s; Tran voltage Voltage Voltage Grav Grav Grav Grav Grav Grav Grav Grav	ference frame; Commonly used reference frames; Transformation be sformation of a balanced set; Balanced steady state phasor relationships; equations.	Baland; Equariable	referenced st	gence eady s of
unit Voltag transfi equati	voltage VIV ge equiormatic ion in a	ference frame; Commonly used reference frames; Transformation be sformation of a balanced set; Balanced steady state phasor relationships; equations. SYMMETRICAL INDUCTION MACHINES ations in machine variables; Torque equation in machine variables on for rotor circuits; Voltage equations in arbitrary reference frame variables; Analysis of steady-state operation; Fest - Free acceleration characteristics viewed from various reference frame.	Baland; Equariable	referenced st	9 of the ence eady

Park's equations; Rotor angle and angle between rotors; Analysis of steady state operation; Dynamic performance during a sudden change in input torque; Dynamic performance during three phase fault at the machine terminals.

		TOTAL PERIODS 45
COURS	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	understand the fundamentals of magnetic circuits.	Understanding (K2)
CO2	learn the steady state and dynamic state operation machine.	of dc Understanding (K2)
CO3	known the theory of transformation of three phase variable two phase variables.	oles to Understanding (K2)
CO4	understand the steady state operation of three-phase indi- machines using transformation theory based mathem modeling.	
CO5	learn the steady state and dynamic state operation of phase synchronous machines using transformation theory mathematical modeling.	

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CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme
Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Programme Outcomes PO's PO₃ CO's PO₁ PO₂ PO4 PO 5 PO 6 CO₁ 3 3 2 2 2 2 CO₂ 3 3 3 3 2 2 CO3 CO₄ 3 3 3 1 CO5 3 3



PPS23	156			IOT	FOR S	MART	SYST	EMS				3	0	0	3
COUR	RSE OF	BJECTIVES													
To ena	ble the	students to													
1	study a	about internet of	f thir	ngs(Io	T) techn	ologies	and its	basics.							no.
2	introdu	uce the network	arch	hitectu	ire and d	esign re	equired f	for IoT							
3	familia	arize the principl	oles b	behind	the inte	rnet cor	nnectivi	ty prin	ciples	for Io	T.				
4		e insight about t													
5		s the application													I S I
UNIT	I	INTRODUCT	TIO	ON TO	O INTE	RNET	OF TH	HINGS	5		HF)	Lije			9
systen	n. API	ural view; Tec	into	ology	bellilla	101 -	SCIVEI	CHG	1 :				•	s of I	oT -
M2M UNIT Drive legacy world	Commers behing deviced forum	IOT NETWO and new network the support; Corn a (IoT WF) sta	ORI ORI ork a ompa	ds, role to IoT, KAR archite aring	e of RFI , M2M a CHITE ectures IoT arched archi	D and I architecture;	ture, so E AND , securi res - Or	oftware DES ity, co ne M2 data m	ons, we and de IGN onstrain	ned d	s sens	or net t tools and	netw	orks,	9 data,
M2M UNIT Drive legacy world comp	Comm T II ers behi y device forum outing, e	IOT NETWO and new network the support; Corn a (IoT WF) statedge computing	ORI ORI ork a ompa tand	k AR archite aring lardize	e of RFI , M2M a CHITE ectures loT arch ed archi ny of edge	D and I architecture; ge, fog a	ture, so E AND , securi res - Or , IoT d and clo	D DES: ity, co ne M2 data moud.	ons, we and dead IGN Onstrain Onstrain Onanage	ned d T star	s sens pmen evices ndardi	or net t tools and zed a	netw rchite	orks,	9 data, Fog
M2M UNIT Drive legacy world comp UNIT	Commers behing deviced forum outing, on T III	IOT NETWO Ind new network e support; Contact (IoT WF) statedge computing INTERNET nectivity; Internet address, IPv6	ORI ORI ORI ORI ORI ORI ORI ORI ORI ORI	k AR archite aring lardize based ddress	e of RFI , M2M a CHITE ectures loT arcl ed archi ny of edg CCTIVI commu	D and I architecture; tecture; tecture; try PR unication a access	ture, so E AND , securi res - Or ; IoT d and clo INCIP	D DES: ity, co ne M2 data m oud. LES ernet p ool; Ap	ons, we and de IGN onstrain 2M Io nanage opportocomplicat	ned d T star	evices and LoWF	or net tools and zed a compu	network rehite state sta	orks, ecture ack -	data, JoT Fog 9
M2M UNIT Drive legacy world comp UNIT Interr the Id HTT	Commers behing deviced forum outing, of T III TOT - III TPS port	IOT NETWO and new network the support; Corn to (IoT WF) statedge computing INTERNET nectivity; Internectivity;	ORI TOOL TOOL TOOL TOOL TOOL TOOL TOOL TOO	k AR archite aring lardize ierarch based ddress	e of RFI , M2M a CHITE ectures loT arcl ed archi my of edg CCTIVI commus; Media	D and I architecture; see, fog a cunication a access	ture, so E AND , securi res - Or and clo INCIP	plication of the place of the p	ons, we and d IGN onstrain 2M Io nanage	ned d T star ols, 6	s sens pmen evices ndardi and LowF	or net tools and zed a computer ALY	netw rehite ate st	orks, ecture ack -	data, , IoT Fog ging in P and
M2M UNIT Drive legacy world comp UNIT Interr the Id HTT UNIT Data mana NOS analy	Commers behing deviced forum outing, of T III met confidered T IV acquiragement SQL, experienced to the confidered to th	IOT NETWO and new network the support; Corn the (IoT WF) stated the computing INTERNET mectivity; Interrept address, IPv6 the support is a control of the computing in the computing in the control of the computing in the control of	ORIO ORIO ORIO ORIO ORIO ORIO ORIO ORIO	k AR archited aring lardized derested based ddress ment, and lo manage	e of RFI , M2M a CHITE ectures loT arcl ed archi ny of edg CCTIVI I commus; Media G, ORG generation spatial bad; An ement; I	D and I architecture; Scale, hitecture; ge, fog a try PR unication a access ANISI on, data storage alytics Knowle D CASE	ture, so E AND , securi res - On and clor INCIP on - Inter s contro NG, PR a acquir e; Orga - Even dge acquir E STUI	plication of the place of the p	ons, we and d IGN onstrain 2M Io nanage orotoco opplicat data g the lytics, man	ned data In-maging	evices and LowF ayer p D AN ation, - Qu emory and s	or net tools and zed a computer of the compute	network rehite ate st IP ad ols - FICS tore, roces	dressing, cessingess.	data, , IoT Fog ing in P and SQL ag and
M2M UNIT Drive legacy world comp UNIT Interr the Id HTT UNIT Data mana NOS analy UNIT IoT	Commerce behing deviced forum outing, or THI met conference of THI met conference outing for THV acquiragement SQL, experies, reserved to the conference of THV application of the conference of	IOT NETWO Ind new network is support; Corn in (IoT WF) statedge computing INTERNET inectivity; Interrept address, IPv6 is. DATA ACQ ing and storage it, server mana extract, transform	Oard ORI	k AR archite aring lardize derarch based ddress RING Data ment, and lo manage e, small e, sma	e of RFI , M2M a CHITE ectures loT arch ed archi ny of edg CCTIVI communication generation spatial bad; And ement; I NS ANI art city, services	D and I architecture; Scale, hitecture; ge, fog a TY PR unication a access ANISIN on, data storage alytics Knowle D CASI smart en	ture, so E AND , securi res - On and clor INCIP on - Inter s contro NG, PR a acquir e; Orga - Even dge acquir E STUI	plication of the place of the p	ons, we and d IGN onstrain 2M Io nanage orotoco opplicat data g the lytics, man	ned data In-maging	bon too s sens pmen evices ndardi and LoWF ayer p D AN ation, - Qu emory and s	or net tools and zed a computer of the compute	network in	dressing, cessing; Case	data, JoT Fog 9 ing in P and SQL ag and e stud

COURS	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	analyze the basic concepts of IoT and its present developments.	Analyzing(K4)
CO2	compare and contrast about different architecture of IoT.	Analyzing(K4)
CO3	explain different internet connectivity principles.	Understanding (K2)
CO4	analyze the data analytic and data acquiring, organising, processing of IoT.	Analyzing(K4)
CO5	implement IoT solutions for smart applications.	Analyzing(K4)

- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, First Edition, 2017.
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			Programme Ou	utcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	-	-
CO2	2	3	- 2	2	-	-
CO3	3	3	2	2	-	-
CO4	2	3	3	1	-	-
CO5	3	3	2	1		2



PPS23157	POWER E	ELE				CS A ENE						W	IN	D A	ND	3	0		0	3
COURSE O	BJECTIVES																			
To enable the	students to																		1.781	
1 impar	t knowledge on	ı wiı	nd (ener	rgy (conve	ersic	on.												
2 famil	arize on differen	ent t	ype	es of	f po	wer c	conv	erter	ers us	ed i	n w	ind	ene	ergy	con	versio	n sy	ste	ms.	
3 under	stand the proces	ess o	of so	olar	ene	rgy co	onv	ersio	on us	sing	pho	otov	olta	aic (PV)	syste	n.			
impa	t detailed knowing) algorithms.	wled	dge	on	gri	d cor	nnec	cted	PV	syst	tem	and	d N	ИРР	T (n	naxim	um	por	wer	point
5 recog	nize the differen	ent c	conf	figu	ratio	on of	hyb	orid e	energ	gy sy	yste	m a	nd	thei	r cor	itrol.				
UNIT I	WIND ENER																			9
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UNIT II Developmen	POWER ELE nt of wind power ower converter,	EC er g	TR gene ulti	d tur RON erati	vics ion;	S FOI Wind	R W	grid VINI ower verte	mon l - Ec D TU r con er, m	gen Cono URE Ivers	BIN sion cell	ES; Po	alys	er co	onvei ; Pov	rters f	or w	vinc	d tur	bine ors fo
UNIT II Developmen Two level p wind power	POWER ELE	EC'rer g	TR gene ulti	d tur RON erati leve	vics ion; el po	Windower of requi	R W d po conv	grid VINI ower verte	mon I - Ec D TU r con er, m s for	gen URE Ivers	BIN sion cell	ES; Po	owe nve	er co	onver ; Pov	rters f	or wemic	vinc	d turi	bine ors for
Development Two level p wind power - Reactive p	POWER ELE nt of wind power ower converter, converter; Controver control - T	rer g rer g retrol Tota	TR gene ulti ls a al h	d tur RON erati leve and g	vics ion; el po grid nonio	Windower of required districtions	R W d po conv irem	wini wini ower verte nents on -	mon I - Ec D TU r con er, m s for Faul	gen URE vers nulti mod	BIN sion cell derr de th	ES; Po	owe nve	er co	onver ; Pov	rters f	or wemic	vinc	d turi	bine ors for
UNIT II Development Two level p wind power - Reactive p issues for w	POWER ELE It of wind power ower converter, converter; Cont ower control - T ind power system	rer grantrol Tota	TR gene ulti al h	eration development of the control o	ion; el po grid nonio	Windower of required districtions with the work of the	R W d po	wini ower verte nents on -	mon l - Ec D TU r con er, m s for Faul	gen URF uvers nulti mod	sion cell dern de th	ES; Po	nwe nve nd	er co	onver ; Povoines abili	rters f wer se - Act ty; En	or wemic	vinconcoov oov	d tur ducto wer c	bine ors for ontro
Development Two level properties wind power - Reactive processes for whether the two systems - Communications and the two systems and the two systems - Communications and the two systems and the two sys	POWER ELE It of wind power ower converter, converter; Cont ower control - T ind power system SOLAR ENE S - Shading effe Grid connected so ow temperature s	rer ger ger ger ger ger ger ger ger ger	GY s on	d turicon de leve eration eration de leve eration erat	rbinonics ONV male pools onto one of the pools one of the pool	Windower of required district systems of the system	R W d po conviirem tortid	grid grid grid grid grid grid grid grid	mon I - Ec D TU r con er, m s for Faul YST forma Solar Envir	gen cono URF vers ulti mod EM em the	omicomicos omicos omico	ES; Po	alys owe nowe nd ugh	er coerter turb cap	onver ; Powines abili	rters f wer se - Act ty; En	ive parents	vine one one one one one one one one one o	d turi ducto wer c g relia	bine ors for ontro ability of PV power
UNIT II Development Two level properties wind power - Reactive processes for well the UNIT III PV module systems - Consistency in the Systems in the UNIT IV	POWER ELE It of wind power ower converter, converter; Control ower control - Trind power system SOLAR ENE S - Shading effective connected so we temperature so POWER ELE	reg were ger ger; mutrol Totalem. TERO ESTEROIS	GY GY TR GY GY TR GY TR GY TR	d turicon eratic	rbine NICS ion; el po grid nonie ONV mo fff gr mal a	Windower of required district systems of the system	the R W d po conviirem tortic	grid grid grid grid grid grid grid grid	r con er, m s for Faul YST forma Solar Envii	gen URF Ivers Invers Invert Invers Invers Invers Invers Invers Invers Invers Invert	sion cell dern de the sion sion cell dern de the sion cell de the sion cell dern de the	e ana ES ; Po l coo n wi nrou sola sylva sola itali	alysowe nve nd algh ar c	er coerter turb cap	onver ; Pow ines abili	rters f wer se - Act ty; En	ive parents	vinconcooving Ty	d turi ducto wer c g relia	bine ors for control ability of PV power
UNIT II Development Two level provided power of the Provided Provi	POWER ELE It of wind power ower converter, converter; Control ower control - To ind power system SOLAR ENE S - Shading effective connected system ower temperature system POWER ELE wes and maximum and P-V curve configuration; Con oc-DC (Direct	reg week, strontrol	GY Sometimes GY MI Tring MI Tring	d turned	rbine NICS ion; el po grid nonic ONV mo fff gr mal a NIC poir unde stag	Windower of required district systems of the particular of the par	the R W d po conviirem tortice SIOI PV rtial ion, ccted nover	grid grid grid grid grid grid grid grid	r coner, mes for Fault Solar Environment To TO tems adding the systems of the sys	gen cono URE nvers nulti moo lt ric EM ance the ronn VOI - E g; Gr ttring tems	S of ermanus LTA	sola sola sylvanica configuration on figuration of figuration on figuration on figuration of figuration on figuration of figurat	owe now and agh ar country steemple SN	cap cells cap ceted cated	onvering providing and content of the content of th	modulate mod	or wemice ive planerg	Ty Ponfi	d turiductory were considered to the considered	bine ors for control ability of PV power voltain tions control
UNIT II Development Two level provided power of the Provided Provi	POWER ELE It of wind power ower converter, converter; Control ower control - To ind power system SOLAR ENE Solar Connected so we temperature so POWER EL wes and maximum and P-V curve configuration; Con	rer g er g er g er muntrol Tota em. ERC exts sola LEC um p entro cum entro	TR gene ultil sa al h GY son artil CTI pov MI ring ol o ultir ingolo o ultir ingo	d turned	rbine NICS ion; el po grid nonic ONV mo fff gr mal a NIC poir jid-co stag multi	Windower of required district symptoms of the particular of the connection of the co	the R W d po conviirem tortice SIO! SIO! SIO! PV Trial ion, cted nover inverting to the single s	grid grid grid grid grid grid grid grid	r coner, mes for Fault Solar Environtems ading this structure base on the research of the structure base of th	gen cono URF avers aulti mod EM ance the ronn VOI - E g; Gr tems tems tems tems tems tems tems tems	sion cell derma sion cell derm	sola system	nd agh ar country steems	cells cap cells cap cetted catio cum converse.	and Con EMS PV nn, A powerte	modulates a PV system C (aler point control of the	cell term	Ty Ponfi	d turiductory were considered to the considered	bine ors for control ability of PV power voltain tions control

HES; DC-bus connected HES; DC-side integration of HES; Three port converters; DC-DC converter; High-frequency link; Neutral-point-clamped multilevel converters with multiple energy sources; Cascaded and modular multilevel converters; Solid state transformers.

		TOTAL PERIODS 45
COUR	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	explain the basics of wind energy conversion system.	Understanding (K2)
CO2	elucidate power conversion in wind energy conversion system.	Understanding (K2)
CO3	describe the process of solar energy conversion system.	Understanding (K2)
CO4	use the converters for solar energy conversion.	Understanding (K2)
CO5	implement the concept of hybrid renewable energy conversion using power converters.	Analyzing(K4)

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- Ersan Kabalci, "Hybrid Renewable Energy Systems and Microgrids", Academic Press, First Edition, 2021.
- Mukund R.Patel, "Wind and Solar Power Systems Design, Analysis and Operation", CRC Press, Third Edition, 2021.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme O	utcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	1	1
CO2	3	3	2	2	1 -	2
CO3	3	3	2	2	2	2
CO4	3	3	3	1	2	100
CO5	3	3	2	1	3	2



PPS2	3158	SOLAR AND ENERGY STORAGE SYSTEMS		3	0	0	3
cou	RSE O	BJECTIVES	- Especial				
To en	able th	e students to	a y fam				
1	know	about the photovoltaic systems.			- Cigi		en
2	unde	rstand the basic knowledge on power conditioning for photovol	taic pow	ver sys	stem.		
3	recog	gnize the measurement and characterization of solar cells and m	odules.		311	on pro	
4	ident	ify the electrochemical storage for photovoltaics.	314		43		
5	get k	nowledge on energy collected and delivered by PV modules.	720	Taff			
UNIT	ΓI	PHOTOVOLTAIC SYSTEMS	N. Elec			= loi	9
Introd	duction	to photovoltaic (PV) Systems; Principles of photovoltaic pov	ver syste	em co	nfigu	ration	
their a	applicat	tion; Components for PV Systems; Future developments in pho	tovoltaio	c syste	em te	chnol	ogy.
UNIT	II T	POWER CONDITIONING FOR PHOTOVOLTAIC PO	WER SY	STE	M		9
Charg	ge cont	rollers and monitoring systems for batteries in PV power s	ystems -	- Cha	rge c	ontro	llers,
Charg	ge equa	aliser for long battery strings; Inverters- General characteri	stics of	PV	inver	ters.	grid-
		stems, stand-alone operation, power quality, active quality con					To
UNIT	ПП	MEASUREMENT AND CHARACTERIZATION OF SO	LAR C	ELLS	ANI)	0
D. d	DV	MODULES					9
		performance; Current versus voltage measurements; Spectral	O COLUMN TO THE OWNER OF THE OWNER O		neasu	ireme	nts -
	20000000	systems, grating-based systems; Module qualification and certi					
UNIT		ELECTROCHEMICAL STORAGE FOR PHOTOVOLT	VARIABLE IN	C 1			9
		ncept of electrochemical batteries; Typical operation con					
		Secondary electrochemical accumulators with internal storage		dary (electr	ochei	nical
		ms with external storage; Investment and lifetime cost consider					
UNIT	-1112	ENERGY COLLECTED AND DELIVERED BY PV MO	The second				9
		Movement between sun and earth; Solar radiation compo					
surfac	ces; Diu	urnal variations of the ambient temperature; Effects of the angle	e of incid	dence	and o	of the	dirt;
Irradia	ation o	n most widely studied surfaces; PV generator behaviour und	er real	operat	ion c	ondit	ions;
Relial	bility ar	nd sizing of stand-alone PV systems.					
		/3/andr2 10 man 1 mm	TOTA	AL PI	ERIO	DS	45
COU	RSE O	UTCOMES					
At the	e end of	f this course, students will be able to		BT M			
COI	1 (1).	istrate the the photovoltaic systems.	(1	Highe	st Le		(K2)
		77.10.10.10.10.10.10.10.10.10.10.10.10.10.					
CO2	2 exp	plain the basic knowledge on power conditioning for		Und	erstan	iding	(K

	photovoltaic power system.	S. Harden
CO3	describe about the measurement and characterization of solar cells and modules.	Understanding (K2)
CO4	use the electrochemical storage for photovoltaics.	Understanding (K2)
CO5	apply the knowledge on energy collected and delivered by PV modules.	Applying(K3)

- Hegedus, S. and Luque, A. eds., "Handbook of Photovoltaic Science and Engineering", John Wiley & Sons 2015.
- Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd., 2015.
- Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, "Applied Photovoltaics", Earthscan, UK, 2017.
- Frank S. Barnes & Jonah G. Levine, "Large Energy Storage Systems Handbook", CRC Press, 2015.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	0,0	and the law of	Programme O	utcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	1 1 1	1
CO2	3	3	2	2	1=	1
CO3	3	3	2	2 ,	1	1
CO4	3	3	3	1	1	2
CO5	3	3	2	1	3	2



	159	PYTHON FOR POWER SYSTEMS EN	GINEERING	3	0	0	3
COUR	SE O	BJECTIVES	e myder ei				
To ena	ble the	students to	-78	KELL			
1	use th	ne basic programming principles such as data types	, variable, conditi	onals, lo	ops,	recur	sior
2		unction calls asic data structures and manipulate text files and im	nages.		-		H
3		iar with machine learning concepts and techniques.			-		
		rstand the process and will acquire skills neces		ly attem	pt a	mac	hin
4		ing problem and implement it using python.			*		
5		iarizing the concepts acquired to improve research/	employability skil	ls.	ш		
UNIT	I	INTRODUCTION TO MACHINE LEARNING	G AND PYTHON	V			9
Introdu	iction	to machine learning- Significance, advantage ar	nd applications; C	Categorie	es of	mac	hin
learnin	g; Ba	sic steps in machine learning - Raw data collect	tion, pre-processi	ing, train	ning	a mo	del
evaluat	tion of	model, performance improvement; Introduction to	python and its si	ignifican	ce; D	iffere	enc
betwee	n C, (C++ and Python Languages; Compiler and interpr	eters; Python3 ins	stallation	and	runn	ing
Basics	of P	thon programming syntax - Variable types, bas	sic operators, reac	ding inp	out fr	om u	isei
Arrays	/list, d	ictionary and set, conditional statements, control flo	ow and loop contro	ol staten	ents.		
UNIT	II	PYTHON FUNCTIONS AND PACKAGES					
File H	andlin	g- Reading and writing data; Errors and except	ions handling: Fu	inctions	and	modi	_
	- Inne				******		iles
Packag	e nan	dling in python; Pip installation and exploring fun	Albaja de Lijing				
		dling in python; Pip installation and exploring fun y and exploring various operations on arrays - Ind	ctions in python	package	Inst	alling	th
numpy	librar		exing, slicing, mu	package ilti-dime	; Insta	alling al arr	th
numpy	librar nump	y and exploring various operations on arrays - Ind	exing, slicing, mu and loading nump	package ilti-dime py array	; Instansion	alling al arr	th
numpy	librar nump	y and exploring various operations on arrays - Ind by arrays, array intersection and difference, saving	ections in python pexing, slicing, mu and loading numped programming w	package ilti-dime py array: vith pyth	; Instansion	alling al arr	the
numpy joining to SciP UNIT	librar nump y pacl	y and exploring various operations on arrays - Index by arrays, array intersection and difference, saving stage and its functions; Introduction to object oriented	exing, slicing, mu and loading num ed programming w	package alti-dime py array with pyth	; Instansion s; Intron.	alling al arr	th
numpy joining to SciP UNIT Descrip	librar nump by pack III ption (y and exploring various operations on arrays - Indo by arrays, array intersection and difference, saving kage and its functions; Introduction to object oriented IMPLEMENTATION OF MACHINE LEARN	exing, slicing, mu and loading num ed programming w ING USING PY'	package, alti-dime py arrays with pyth THON lataset, E	; Instansion s; Intro on.	alling al arr roduc	the
numpy joining to SciP UNIT Descrip dataset	librar ; nump by pack III ption (by and exploring various operations on arrays - Independent of a standard datasets - Coco, imagenet, MNIST (har	exing, slicing, mu and loading num ed programming w ING USING PY adwritten digits) d	package: alti-dime py arrays with pyth THON ataset, E gistic re	; Instansion s; Intro on.	alling al arr roduce	the
numpy joining to SciP UNIT Descrip dataset analytic	librar nump by pack III ption or ; Intr	y and exploring various operations on arrays - Indep of arrays, array intersection and difference, saving stage and its functions; Introduction to object oriented implementation of Machine Learn of standard datasets - Coco, imagenet, MNIST (har oducing the concepts of regression; Linear, position)	exing, slicing, mu and loading numped programming was ING USING PY' adwritten digits) delynomial and log is functions; Pytho	package: alti-dime py arrays with pyth THON ataset, E gistic re on applic	; Instansion s; Intro on. Boston egress	alling al arr roduce n hou ion	the
numpy joining to SciP UNIT Descrip dataset analytic regress	ibrar nump by pack iii ption or ; Intr cal un	y and exploring various operations on arrays - Indep of arrays, array intersection and difference, saving tage and its functions; Introduction to object orients of standard datasets - Coco, imagenet, MNIST (har oducing the concepts of regression; Linear, poderstanding; Introduction to SciPy package and its	exing, slicing, mu and loading numped programming was ING USING PY' adwritten digits) delynomial and log is functions; Pytho	package: alti-dime py arrays with pyth THON ataset, E gistic re on applic	; Instansion s; Intro on. Boston egress	alling al arr roduce n hou ion	the
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numpy joining to SciP UNIT Descript dataset analytic regress and exa	librar nump by pack III ption of ; Intr cal un sion ar ample	y and exploring various operations on arrays - Index by arrays, array intersection and difference, saving kage and its functions; Introduction to object oriented in IMPLEMENTATION OF MACHINE LEARN of standard datasets - Coco, imagenet, MNIST (har oducing the concepts of regression; Linear, poderstanding; Introduction to SciPy package and its and polynomial regression using SciPy; Interpolation susing SciPy.	exing, slicing, must and loading numped programming we ING USING PY' adwritten digits) delynomial and log is functions; Pytho on, overfitting and	package, alti-dime py arrays with pyth THON ataset, E gistic re on applic	s; Instansion s; Intro on. Boston egress ration fitting	alling al arr roduce h hou ion of li-	the ays
numpy joining to SciP UNIT Descrip dataset analytic regress and exa UNIT Introdu	ibrar y pack iii ption o ; Intr cal un sion ar ample IV	y and exploring various operations on arrays - Indep of arrays, array intersection and difference, saving stage and its functions; Introduction to object orients of standard datasets - Coco, imagenet, MNIST (har oducing the concepts of regression; Linear, posterstanding; Introduction to SciPy package and its and polynomial regression using SciPy; Interpolations using SciPy. CLASSIFICATION AND CLUSTERING COMMAND CLUSTERING COMM	exing, slicing, must and loading numped programming we ING USING PY' adwritten digits) delynomial and log is functions; Python, overfitting and	package: alti-dime py arrays with pyth THON ataset, E gistic re on applic I underfi	s; Instansion s; Intro on. Boston egress cation itting	alling al arr roduce n hou ion of li- conc	th ays tion with near ept
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clustering algorithm; Introduction to python visualization using Matplotlib - Plotting 2- dimensional, 3dimensional graphs, formatting axis values, plotting multiple rows of data in same graph.

UNIT V INTRODUCTION TO NEURAL NETWORKS AND EMBEDDED MACHINE LEARNING

Introduction to neural networks and significance – Neural network architecture, single layer perceptron and multi-layer perceptron (MLP), commonly used activation functions; Forward propagation, back propagation, and epochs, gradient descent; Introduction to convolution neural networks; Implementation of digit classification using MNIST dataset ML for embedded systems

		TOTAL PERIODS 45
COURS	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	implement skill in system administration and network programming by learning python.	Applying(K3)
CO2	demonstrate the concepts of machine learning and implement using python.	Understanding (K2)
CO3	relate Pythons highly powerful processing capabilities for primitives, modelling etc.,	Applying(K3)
CO4	improve the employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded systems design.	Understanding (K2)
CO5	apply the concepts acquired over the advanced research/employability skills.	Applying(K3)

REFERENCES

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- Zelle, John "M. "Python Programming: An Introduction to Computer Science.", Franklin Beedle & Associates, 2013.
- Andreas C. Müller, Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly, 2016.
- Sebastian Raschka , Vahid Mirjalili, "Python Machine Learning Third Edition", Packt, December 2019.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme Ou	itcomes PO's		H 10
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2		
CO2	3	3	2	2	maur - malu	I manual
CO3	3	3	2	2	werte annumen	nipad- wir
CO4	3	3	3	1	al lea - amb ou	
CO5	3	3 .	2	1 .	-1,	-



PPS	23160									LITY							AND		3	()	0	3
COU	RSE O	BJECTIVES																					
To en	able the	e students to																					
1	recog	gnize the basic	of e	el	le	ecti	tro	ma	agn	netic	com	pati	tibili	ity ar	d its	app	licati	on.					
2	impa	rt knowledge o	on c	cal	abl	olir	ng	gan	nd g	groui	ndin	ng fi	unda	amen	tals.	112		115		-112		- 44	
3		v about the imp																			ď		
4	acqu	ire knowledge	on	ı el	ele	ect	tro	oma	agn	netic	inte	erfac	ce (I	EMI)	froi	n ap	parat	ıs an	d circu	its.			
5	THE	erstand the proc																	10 11			6.1	1.1
UNI		ELECTRON														D A	PPLI	CAT	IONS				9
UNI		CABLING							upi		- copie		-	CHE							n		9
calcı	acitive (coupling; Effect; Effect of shie	et c	on	n s	sh	hie naș	eld	on	c cou	NG paciti uplin	ive	cou	ipling	g; In	prev	ent m	agne	tic rad	iatio	n;	Shie	lding
calcu a rec	ulations ceptor a	coupling; Effect ; Effect of shie against magnet ands; Signal grounds;	ect o	on fi	n son	sh m eld Ed	hie nas ds;	eld igno	on etic omr	c cou mon	NG paciti uplin imp	ive ng; S peda	Shie	ipling	g; Ing to	prev	ent m ling;	agne	tic rad	iatio	n;	Shie	lding
a rec	ulations ceptor a cy groun	coupling; Effect ; Effect of shie against magnet ands; Signal grou	ect of eld of etic ound	on fi	n son fiel s;	sh meld Ed	hie naş ds; equ	eld igne co uipi	on etic omr	c cou	oaciti uplin impround	ive ng; \$ peda iding	Shie lance	ipling elding e shi	g; Ing to eld o	prev coup ops.	ent m	AC	tic rad	dist	on; trib	Shie	lding and
a rec safet UNI Bala Con	acitive oulations deptor a ground ty ground the control of the con	coupling; Effect ; Effect of shie against magnet ands; Signal grounds;	ect of eld etic ound NG	on finds	n son fiel s; All rejection	sh meld Ed	hie maş ds; dqu ctic	eld agneric country of FI	on etic omr	mon ent gr	paciti uplin impround a impround a interest	ive ng; \$ peda iding e ba s; Pe	Shie lance lang; G	apling elding e shi droun ce, sy	g; Ing to eld of lo	prev coup ops.	ent m ling; lance	AC , bala	nced	dist	s; l	Shie oution Filter acy a	lding n and ring -
a recessafet UNI Bala Comcirculandi	ceptor and ground the second s	coupling; Effect i; Effect of shie against magnet ads; Signal grou BALANCIN Common mod node filters, pa	ect of eld of el	on finds	n son fiel s; All reje	sh melding Economic Control of the c	hie may ds; dqu ctic eff	eld agneric coupling FI	on etic	m cap c cou mon ent gr FERI tio, c in fi	oaciti uplin impround ING Cable	pedading e ba	Shie lance ang; G	upling elding e shi droun cce, sg	g; Ing to g to d lo	prev coup ops.	ent m ling; lance	AC , bala	nced	dist	s; l	Shie oution Filter acy a	lding n and ring -
calcular recisafet UNI Bala Commission andi UNI Electronic moduline indu	acitive of allations deptor a cy ground T III and and a cy ground mon and a cy ground to the cy ground to th	BALANCING AND	ect of eld stic ound of the ou	on fields AI AI AI Constitution on the constitution of the constit	n son field s; All rejoition different strain strai	sh melde Ed Ni jec c c c dec PPA	hie mag ds; equ totic eff con AF este sur	FI couple RA in co	on etic omramer interest in the state of the	reaper country and application on means and application on means and application on means and application and	oaciti uplin i imp round ING cable iilters Drivin ance iance es; N tion; or lin nain	ive ng; s peda ding e ba ding CI es; Pa pov	Shie shie shie shie shie shie shie shie s	upling lelding e shiding round ce, si se fi se f	g; Inng to g to d loo d	prevops. m ba decoads: rela n ci odu n po Elec	lance oupli System sys an reuits lation wer stroma	AC , balang – eem I d sw	inced Low bandw itches Ampli	load load load load load load load load	s; luer calc	Shie sution Filter acy a Modu uit nonline ansm	lding and
calcular reconstant and reconstant a	acitive of allations deptor a cy ground T III and and a cy ground mon and a cy ground to the cy ground to th	BALANCING Common mode filters, paroupling, amplitude emission racteristics, efficient conductor limited and conductor limited control in the common mode filters and compling common mode filters.	ect of eld stic ound of the ou	on fields ads	n since on field six and six a	sh m Edded NI Sys o cro hre	hie mag	FI on fee oupl	on etic omramer rate rate in the state of th	reaper country and caper count	oaciti uplin i imp round ING cable iilters Drivin AND iance es; N tion; or lin nain	ive ng; s peda ding e ba ding e ba color ng colo	Shie course Shie course Shie course Shie course Shie capacitation of the capacitation	upling lelding e shiding round ce, si se fi se f	g; Inng to g to d loo d	prevops. m ba decoads: rela n ci odu n po Elec	lance oupli System sys an reuits lation wer stroma	AC , balang – em I d sw	inced Low bandw itches Ampli	load load load load load load load load	s; luer calc	Shie sution Filter acy a Modu uit nonline ansm	lding and

grounding; Non grounded products; Field induced upset; Transient hardened software design; Time windows.

		TOTAL PERIODS	45
COURS	SE OUTCOMES		
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)	
CO1	explain the basics of electromagnetic compatibility and its application.	Understanding (K	K2)
CO2	describe the process of on cabling and grounding fundamentals.	Understanding (K	K2)
CO3	elucidate the importance of balancing and filters.	Understanding (K	K2)
CO4	examine the effect of electromagnetic interface (EMI) from apparatus and circuits.	Understanding (K	K2)
CO5	implement the concept electrostatic discharge in various applications.	Applying(K	K3)

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- David A. Weston, "Electromagnetic Compatibility: Methods, Analysis, Circuits and Measurement", CRC Press, Third Edition, 2016.
- Clayton Paul, "Introduction to Electromagnetic Compatibility", John Wiley & Sons, Inc., Third Edition, 2022.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's							
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6		
CO1	3	3	2	2	-	-		
CO2	3	3	2	2	-			
CO3	3	3	2	2	-	-		
CO4	3	3	3	1		-		
CO5	3	3	2	1	-	-		



PS2	3161		POWER Q	PS23161 POWER QUALITY 3 0				0	0	3
COU	RSE OB	BJECTIVES							10000	nine.
o en	able the	students to								
1	provid	e knowledge ab	t various power qu							
	unders	stand the conce	of power and pow	ver factor in sin	ngle phase	and thre	e ph	ase	syst	ems
2	supply	ing nonlinear lo	is.							
	equip	with required s	ills to design conv	entional compe	nsation tech	nniques	for p	ow	er fa	ctor
3		tion and load vo								
-			chniques for the act	ive compensatio	n.					an.
4			on techniques using			h as DS	TAT	CO	M, I	VR
5	and U									
		INTRODUCT	ON					T		9
UNI			ower quality - Tr		1 4	J lane	diam	tion		1
	lanced lo	oads, DC offset	Power quality pro loads, notching in	load voltage; D	isturbance i	n supply	vol	tage	- Pe	ower
quali UNI Sing linea unba	T II tle phase ar and no	ands, DC offset ards. ANALYSIS Continear and nonconlinear loads — and distorted so	SINGLE PHASE near loads – single hree phase balance ree supplying non-	AND THREE e phase sinusoid d system, three	PHASE SY dal, non-sinu	STEM usoidal sanced sy	sourc	e; s	Supplinee p	9 lying
quali UNI Sing linea unba three	T II the phase ar and no alanced at the wire, the	ANALYSIS Continear and non and distorted so	SINGLE PHASE near loads – single hree phase balance ree supplying non-vire system.	AND THREE e phase sinusoid d system, three linear loads; Co	PHASE SY dal, non-sinu phase unbala	STEM usoidal sanced sy	sourc	e; s	Supplinee p	9 lying phase hase-
quali UNI Sing linea unba three UNI Prin bala Ana	T II the phase of an and no alanced are wire, the ciple of ancing, coulysis of the ciple of the	ANALYSIS Continuation of the continuation of t	SINGLE PHASE near loads – single hree phase balance ree supplying non-	AND THREE e phase sinusoid d system, three linear loads; Co PENSATION M lation; Classical cing, harmonic	PHASE SY dal, non-sinuphase unbala oncept of po	STEM usoidal s anced sy ower fac	source stem	ee; !! Thr	Supplinee place place	9 lying chase hase-
qualification of the second of	T II the phase ar and no alanced are wire, the ciple of ancing, controlly is a ponent for its interest.	ANALYSIS Continues and non- and distorted some phase - four convention load compensate losed loop bala unbalance - Institution measured. LOAD COM	SINGLE PHASE near loads — single hree phase balance ree supplying non- vire system. NAL LOAD COM n and voltage regulating, current balan ntaneous of real and	AND THREE e phase sinusoid d system, three linear loads; Co PENSATION M lation; Classical cing, harmonic d reactive power	PHASE SY dal, non-sinuphase unbala oncept of po METHODS load balance reduction a s; Extraction	STEM usoidal s anced sy ower fac	source source stem stor;	ree; Stage	Suppose pose pose pose pose pose pose pose	lying phase hase-loop ction uence
qualification of the community of the co	T II the phase ar and no alanced are wire, the ciple of ancing, continuous of the phase of the	ANALYSIS Continued and distorted some phase - four CONVENTION load compensations and losed loop balantalance - Institute and measured. LOAD COMMING single-phase and instantaneous urrents when the continue and	SINGLE PHASE near loads — single hree phase balance ree supplying non- vire system. NAL LOAD COM n and voltage regu- reing, current balan ntaneous of real and ENSATION USIN ads; Ideal three ph PQ theory; Instant e source is unbal	AND THREE e phase sinusoid d system, three linear loads; Co PENSATION M lation; Classical cing, harmonic d reactive power G DSTATCOM ase shunt competaneous symme	PHASE SY dal, non-sinuphase unbala oncept of po METHODS load balance reduction a s; Extraction densator structured comp	rSTEM usoidal sanced syrower factoring production of functions to the contents	source/stem blem age s dame	tage ee; tage ee; tage a - (ag ental ting	Supposer popular sequences produced in seque	9 llying shase hase-loop loop ction uence
qualification of the community of the co	T II the phase ar and no alanced are wire, the ciple of ancing, continuous of the phase of the	ANALYSIS Continues and non- and distorted some phase - four convention load compensate and losed loop bala unbalance - Institution measured. LOAD COM Ing single-phase and instantaneous urrents when the M in voltage continues and in voltage conti	SINGLE PHASE near loads — single hree phase balance ree supplying non- vire system. NAL LOAD COM n and voltage regu- reing, current balan ntaneous of real and ENSATION USIN ads; Ideal three ph PQ theory; Instant e source is unbal	AND THREE e phase sinusoid d system, three linear loads; Co PENSATION M lation; Classical cing, harmonic d reactive power G DSTATCOM ase shunt competaneous symme anced; Realizat	PHASE SY dal, non-sinuphase unbala oncept of po METHODS load balance reduction a s; Extraction densator structurical comp ion and co	rSTEM usoidal sanced sy ower face cing pro nd volta n of funce cture; Ge onents to	source stem tor; blem age s dame	tage ee; tage ee; tage a - (ag ental ting	Supposer popular sequences produced in seque	9 lying shase hase-loop ction uence

tra

		TOTAL PERIODS 45
COURS	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	comprehend the consequences of power quality issues.	Understanding (K2)
CO2	conduct harmonic analysis of single phase and three phase systems supplying non-linear loads	Understanding (K2)
CO3	design passive filter for load compensation.	Analyzing(K4)
CO4	design active filters for load compensation.	Analyzing(K4)
CO5	understand the mitigation techniques using custom power devices such as distribution static compensator DSTATCOM,	Understanding (K2)
	dynamic voltage restorer DVR and UPQC.	

- Arindam Ghosh and Gerad Ledwich "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, First Edition, Reprint 2019.
- G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, Second Edition, Reprint 2016.
- R.C.Duggan "Electric Power Systems Quality", Tata MC Graw Hill Publishers, Third Edition Reprint, 2019.
- 4. Derek A.Paice "Power Electronic Converter Harmonics" IEEE Press, 2014.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's							
CO's	PO 1	PO 2	- PO 3	PO 4	PO 5	PO 6		
CO1	3	3	2	2	1	1		
CO2	3	3	2	2	1	1		
CO3	3	3	2	2	1	1		
CO4	3	3	3	1	2	3		
CO5	3	3	2	1	2	3		



PPS	23162	APPI	CATION OF DSP TO POWE PROTECTION	R SYSTEM	3	0	0	3
COL	JRSE O	BJECTIVES						
To e	nable the	e students to	inge of mileyle films	Tomate Con	in the same			
1	expos	se the students to	earn about DFT and wavelet tran	sforms.		ig Hi		
2	provi		nowledge on the components	used for the i	implementa	ition	of d	igital
3	impa	rt knowledge on	fferent algorithms for digital pro	tection of powe	r system co	ompoi	nents.	
4	imple	ment digital prot	ction for transformer.					R.
5	under	stand different d	ision making methodologies in p	protective relays	S.	- 71		
UNI	TI	DIGITAL SIG	AL PROCESSING TECHNIQ	QUES		14 11		9
Fast	fourier t	ransforms; Wave	liasing, decimation, interpolation t transform; Numerical algorithm		liscrete fou	rier tr	ansfo	orms;
UNI	ТП	DIGITAL PRO	TECTION					9
Sinus Wals	soidal w	ave based algorit on analysis- Leas	Interpolation, numerical differ ms -First and second derivative squares based methods, differen	method, two artial equation ba	nd three sar	nple 1	techn	ique;
			ased algorithms; Least square co	arve fitting algo	rithm.		IN	19
	T IV		TECTION TECHNIQUES					9
prote volta Slidi	ection; I ge, curr ng wind	Digital line different, impedance, dow, FWHT, significant	r based algorithm - Basic hardwantial scheme; Measurement algorithm scheme; Measurement algorithm scheme; Measurement algorithm scheme; Short window Wave all analysis and synthesis; ACong in fault analysis.	gorithms for di elet based fault	gital prote identificat	ction ion te	– Po	ower,
UNI	ΤV	DIGITAL PRO	TECTIVE RELAYS					9
Deci: relay	sion mal	king with multipl	relays- Deterministic decision criteria; Adaptive decision scher numbers, Boolean versus fuz control.	mes; Elements o	of fuzzy log	gic in	prote	ctive
1.1					TOTAL P	FDIC	one	45

u

At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	apply DSP techniques for digital protection.	Applying(K3)
CO2	make decision to implement suitable algorithm for digital relaying applications.	Understanding (K2)
CO3	employ FIR based algorithms for digital relaying.	Applying(K3)
CO4	do transformer protection using digital techniques.	Understanding (K2)
CO5	perform coordinated operation of relays for specific purposes.	Applying(K3)

- J.L. Blackburn, "Protective Relaying: Principles and Applications", Marcel Dekker, New York, Seventh Edition 2016.
- A.G. Phadke and J.S. Thorp, "Computer Relaying for Power Systems", John Wiley & Sons, New York, Reprint 2013.
- 3. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms", 2017.
- Y.G. Paithankar and S.R Bhide, "Fundamentals of Power System Protection", PHI Learning, Second Edition Reprint 2018.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

III TABLE			Programme O	utcomes PO's		
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3	3	2	2	3	2
CO2	3	3	2	2	3	2
CO3	3	3	2	2	2	2
CO4	3	3	3	1	2	2
CO5	3	3	2	1	2	2



	3163	S	3	0	0	3	
COU	RSE O	BJECTIVES		State of			
To en	able the	e students to		200			
1	know	about the function	onal requirements of SCADA.	GLV plu			=)
2	infer	the system comp	onents of SCADA.		ea sw	76	
3	under	rstand the commu	unication protocols used in SCADA.	der müner	Time	H	
4	interp	oret the monitorin	ng and control process of SCADA.				Ħ
5	identi	ify the SCADA a	pplication in power system.	in bird			
UNIT	I	INTRODUCT	ION TO SCADA				9
Evolu	tion of	SCADA, SCAD	A definitions, SCADA functional requirement	ts and compor	nents.	SCA	
			architecture, general features, SCADA applic		-		
UNIT			EM COMPONENTS	700	-	7.11	9
Remo	te tern	ninal unit (RTU); Interface units - Human-machine interf	face units (F	IMI):	Disr	la
			; Intelligent electronic devices (IED); Comm				
					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	50,1	-
SOL VOL	, SCAL	A control system	ns and control panels.				
			ns and control panels. MUNICATION				0
UNIT	Ш	SCADA COM	MUNICATION	present and fi	iture s	struct	9
UNIT	III OA com	SCADA COM	MUNICATION irrements; Communication protocols - Past, p				ture
UNIT SCAD of a S	III OA com	SCADA COM	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication	cation protoco	ols; IE	C61	850
UNIT SCAD of a S based	OA com	SCADA COM nmunication requ communication unication archite	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic,	cation protoco	ols; IE	C61	850
UNIT SCAD of a S based and co	OA com CADA common	SCADA COM numunication requ a communication unication archite ication extension	MUNICATION irrements; Communication protocols - Past, pas protocol, comparison of various communicature; Communication media - Fiber optic, s, synchronization with NCC and DCC.	cation protoco	ols; IE	C61	850
UNIT SCAD of a S based and co	OA com SCADA communi	SCADA COM numunication required communication unication archite ication extension	MUNICATION direments; Communication protocols - Past, protocol, comparison of various communication; Communication media - Fiber optic, s, synchronization with NCC and DCC.	cation protoco	ols; IE	C61 ovisi	850 on:
UNIT SCAD of a S based and co UNIT Online	OA common ommunication of the common ommunication of the communication o	SCADA COM numunication required communication unication archite ication extension SCADA MON toring the event	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block	cation protoco PLCC; Interfa	nt dist	cvisi ovisi turba	850 on:
UNIT SCAD of a S based and co UNIT Online	OA commonmunity IV	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event pontrol function - S	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block Station control, bay control, breaker control and	cation protoco PLCC; Interfa	nt dist	cvisi ovisi turba	850 on
UNIT SCAD of a S based and co UNIT Online record	OA commonmum IV e moniting; Co	SCADA COM numunication required communication archite ication extension SCADA MON toring the event ontrol function - SCADA APPL	MUNICATION direments; Communication protocols - Past, protocol, comparison of various communication; Communication media - Fiber optic, s, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM	cation protoco PLCC; Interfa- king list, eve and disconnected	nt dist	cc61 ovisi turba	9 ncc
UNIT SCAD of a S based and co UNIT Online record UNIT Applie	OA commonmunity IV e moniting; Co v cations	SCADA COM numunication required communication archite ication extension SCADA MON toring the event ontrol function - SCADA APPL in generation,	MUNICATION direments; Communication protocols - Past, protocol, comparison of various communication; Communication media - Fiber optic, so, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Sub-	cation protoco PLCC; Interfa- king list, evend disconnectors estation SCA	nt dist	cc61 ovisi turba	9 n
UNIT SCAD of a S based and co UNIT Online record UNIT Applie	OA commonmunications (CADA) communications (scada communication requirements of a communication archite ication extension scada Monitoring the event control function - Scada APPL in generation, systematical systematic	munication irements; Communication protocols - Past, pass protocol, comparison of various communication; ceture; Communication media - Fiber optic, sa, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as	cation protoco PLCC; Interfa- king list, eve and disconnector estation SCAl	nt dist	cc61 ovisi turba trol.	9 nce
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi	OA common or community of the community of the common or community of the	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event ontrol function - S SCADA APPL in generation, description, systen	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as a; SAS cubicle concepts, gateway interoper	cation protoco PLCC; Interfa- king list, eve and disconnector estation SCAl	nt dist	cc61 ovisi turba trol.	9 nce
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi	OA common or community of the community of the common or community of the	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event ontrol function - S SCADA APPL in generation, description, systen	munication irements; Communication protocols - Past, pass protocol, comparison of various communication; ceture; Communication media - Fiber optic, sa, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as	cation protoco PLCC; Interfa- king list, eve and disconnected estation SCAl is substation rability list, s	nt dist	cC61: ovisi turba turba rerol.	9 nce
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi IEC61	OA common or community of the monitoring; Co v cations on all dispersions; Systems (Systems)	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event ontrol function - S SCADA APPL in generation, description, system and configuration term installation, to	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as a; SAS cubicle concepts, gateway interoper	cation protoco PLCC; Interfa- king list, eve and disconnector estation SCAl	nt dist	cC61: ovisi turba turba rerol.	9 n ion
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi IEC61 concep	OA common or community of the common or community of the	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event ontrol function - S SCADA APPL in generation, description, system term installation, to	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; ceture; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as as; SAS cubicle concepts, gateway interoper sesting and commissioning.	cation protoco PLCC; Interfa- king list, even disconnector estation SCAl s substation rability list, s	nt distor content DA syconfigures	cC61 ovisi turba trol.	9 n ion
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi IEC61 concep	OA common or community of the common or community of the	SCADA COM numunication required communication archite unication extension SCADA MONI toring the event ontrol function - S SCADA APPL in generation, description, system term installation, to	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as a; SAS cubicle concepts, gateway interoper	cation protoco PLCC; Interface king list, eve and disconnecte estation SCA s substation rability list, s TOTAL P	nt dist	turba turba turba turba turba turba nam	9 n ion
UNIT SCAD of a S based and co UNIT Online record UNIT Applic Functi IEC61 concep	OA common or second of the common of the com	SCADA COM Immunication required communication archite ication extension SCADA MON Itoring the event control function - SCADA APPL in generation, lescription, system configuration installation, the course, studient course, studient course, studient course, studient communication requirements and configuration installation, the course, studient course, studient communication requirements and communication requirements and communication requirements are communication architecture.	MUNICATION direments; Communication protocols - Past, pass protocol, comparison of various communication; ceture; Communication media - Fiber optic, as, synchronization with NCC and DCC. ITORING AND CONTROL and alarm system, trends and reports, block station control, bay control, breaker control and ICATIONS IN POWER SYSTEM transmission and distribution sector; Subsem specification, system selection such as as; SAS cubicle concepts, gateway interoper sesting and commissioning.	cation protoco PLCC; Interface king list, eve and disconnecte estation SCA s substation rability list, s TOTAL P. BT M (Higher	nt dist	cc61: covisi turba turba turba turba turba turba turba	9 nconing

CO2	explain the various system components and control panels in SCADA.	Understanding (K2)
CO3	analyze the SCADA communication protocols.	Analyzing(K4)
CO4	investigate the control and monitoring functions of SCADA.	Applying(K3)
CO5	describe the SCADA application in power system.	Understanding (K2)

- Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2014.
- Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK, 2014.
- 3. William T. Shaw, "Cyber Security for SCADA systems", Penn Well Books, 2016.
- 4. David Bailey, Edwin Wright, "Practical SCADA for Industry", Newnes, 2018.

CO-PO MAPPING

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	Programme Outcomes PO's							
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6		
CO1	.3	3	2	2	1	1		
CO2	3	3 .	2	2	1	1		
CO3	3	3	2	2	2	1		
CO4	3	3	3	1	2	3		
CO5	3	3	2	1	2	3		



PPS23	164	FAC	TS AND CUSTOM POW	ER DEVICES		3	0	0	3
COUR	SE OB	JECTIVES							
To enal	ble the s	students to							
1	infer th	e basic concept	of transmission systems and	FACTS controllers	s.				
2	identify	the suitable co	npensator and its control.						
3	review	various series c	empensation techniques.						
4	know a	bout unified pov	ver flow controller.						
5	underst	and the modelli	ng of interline power flow co	ontroller.					
UNIT	I I	BASICS OF TH	ANSMISSION SYSTEM	AND FACTS CO	NTROL	LER	ts		9
Reactiv	e powe	r flow control is	power systems; Control of	dynamic power un	n-balanc	es in	pow	er sys	tem;
Power	flow co	ntrol; Constrain	s of maximum transmission	line loading; Bene	efits of I	FACT	S tra	nsmi	sion
line cor	mpensa	tion: Uncompen	sated line -Shunt compensat	tion, series comper	sation:	Phase	e ang	le cor	trol:
			Shunt and series comp						
	100	nd distribution le							
			Description of the law	SEVERAL SERVICE					
UNIT I		SVC AND STA							9
Static v	ersus p	assive VAR con	pensator; Static shunt comp	ensators - SVC and	d STAT	COM	l, ope	ration	and
control	of TSC	, TCR and STA	COM, compensator contro	l; Comparison betw	veen SV	C and	d STA	ATCC	M.
UNIT	ш	STATIC SERI	S COMPENSATION						9
TSSC,	SSSC;	Static voltage	and phase angle regulators	; TCVR and TCF	PAR op	eratio	n an	d con	itrol,
applica	tions; S	tatic series comp	ensation - GCSC, TSSC, T	CSC and their cont	rol.				
UNIT	IV	UNIFIED POW	ED ELOW CONTROLL	ER ,	eten M	e pre		45	9
			EKTLUW CUNIKULLI						1 of
		amping; Unifie	Properties to the power flow controller - 0	Circuit arrangemen	it, opera	ation	and	contr	01
	Basic p								
		orinciple of P and	power flow controller -	l and reactive powe					
UPFC;	v	rinciple of P and	I power flow controller - Q control; Independent rea	l and reactive powe	er flow o	contro	ol, ap	plicat	ions.
UPFC; UNIT	V inction to	INTERLINE Pointerline power	Q control; Independent rea	l and reactive power LLER and analysis of FA	CTS co	ntroll	ol, app	plicat Simul	ons. 9 ation
UPFC; UNIT ! Introdu	V inction to	INTERLINE Pointerline power	Q control; Independent real	LLER and analysis of FA bution systems, ha	CTS co	ntroll s; Lo	ers; S	Simul hat c	9 ation
UPFC; UNIT V Introdu of FAC	V netion to	INTERLINE Pointerline power introllers; Power odeling, harmon	OWER FLOW CONTROL flow controller; Modeling quality problems in distri	LLER and analysis of FA bution systems, ha	CTS co	ntroll s; Lo	ers; S ads t	Simul hat c	9 ation reate nics,
UPFC; UNIT VIIntrodu of FAC harmon passive	V Inction to	INTERLINE Pointerline power introllers; Power odeling, harmon active filtering;	OWER FLOW CONTROL flow controller; Modeling quality problems in distri	LLER and analysis of FA bution systems, ha parallel resonance and their control; Po	CTS confirmation of the co	ntroll s; Lo ation	ers; sads to of hossues	Simul hat c	9 ation reate nics,
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SONIO DE EN PIEN

At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	distinguish the performance of transmission line with and without FACTS devices	Understanding (K2)
CO2	compare the SVC and STATCOM.	Analyzing(K4)
CO3	describe the operation and control of various static series compensators.	Understanding (K2)
CO4	explain the operation and control of unified power flow controller.	Understanding (K2)
CO5	distinguish various power quality issues and how are they mitigated by various FACTS devices.	Understanding (K2)

- K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Publishers, 2017.
- N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, Reprint 2019.
- X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", Springer Verlag, Berlin, Reprint 2017.
- K.S.Suresh Kumar, S.Ashok, "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2016.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's							
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6		
CO1	3	3	2	2	1	1		
CO2	3	3	2	2	2	2		
CO3	3	3	2	2	2	2		
CO4	3	3	3	1	2-	3		
CO5	3	3	2	1	1	3		



PPS23165 COMI			PUTER RELAYING AND WIDE AREA MEASUREMENT SYSTEMS 3 0					0	3			
COUL	RSE C	BJECTIV	VES					elona.			0	nis
To ena	able th	e students	to	The same			no Intere	enejmo	The second			
1	discr	iminate co	onventio	nal relay	s and con	puter relays.	olin ar Eg		al a			(60)
2	comp	orehend the	e operat	ing valu	es of a cor	nputer relays	. I deal	1.10 1.50	i Carry			
3		ide expositation, syst				ement system	ns through th	e compu	ter h	ierarc	hy ir	the
4	incul	cate know	ledge or	phasor	measuren	nent unit and	its application	n to powe	r syst	tem.		m
5	enha	nce the cor	nvention	nal powe	er system s	studies with v	vide area mea	surement	techi	nique	S.	OT
UNIT	I	INTRO	DUCTI	ON		In the same	of the est	index in	u little			9
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EUGSECHEN TO

At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
C01	demonstrate knowledge of fundamental theories, principles and practice of computer relaying, wide area measurement system.	Understanding (K2)
CO2	analyze the power system with computer relaying and wide area measurement system.	Analyzing(K4)
CO3	validate the recent relaying technologies which work towards smart grid.	Understanding (K2)
CO4	design wide area measurement systems for smart grid.	Analyzing(K4)
CO5	compare the performance of modern relaying schemes and measurement techniques with the conventional one.	Analyzing(K4)

- A.G. Phadke, J.S. Thorp, "Computer Relaying for Power Systems", John Wiley and Sons Ltd., Research Studies Press Limited, Second Edition, Reprint 2019.
- A.G. Phadke, J.S. Thorp, "Synchronized Phasor Measurements and Their Applications", Springer, First Edition, Reprint 2018.
- Antonello Monti, Carlo Muscas, FerdinandaPonci, "Phasor Measurement Units and Wide Area Monitoring Systems" Academic Press, 2016.
- 4. Stanley H. Horowitz, Arun G. Phadke, "Power System Relaying", John Wiley & Sons, 2013.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's								
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6			
CO1	3	3	2	2	1	1			
CO2	3	3	2	2	1	1			
CO3	3	3	2	2	1	1			
CO4	3	3	3	1	1	1			
CO5	3	3	2	1	3	3			



	23166	ENERGY MANAGEMENT AND AUDITING 3	0	0	3
cou	RSE O	BJECTIVES			
To er	nable the	e students to			
1	unde	rstand the present energy scenario and role of energy managers.	A E I		
2	comp	prehend the economic models for cost and load management.	ZID		
3	confi	gure the demand side energy management through its control technique ning.	s, stra	tegy	and
4	unde	rstand the process of energy auditing.			-
5	know	energy conservation aspects in industries.	, illine		
UNI	ГІ	ENERGY SCENARIO	uji li		9
Basic	s of en	ergy and its various forms - Conventional and non-conventional sources;	Energy	poli	cy .
		ervation act 2001, amedments (India) in 2010; Need for energy managen		(3)	
		an energy management program; Energy managers and energy audit			
		ies of energy managers; Energy labelling and energy standards.			
UNI	гп	ENERGY COST AND LOAD MANAGEMENT		HE.	9
Impo	rtant co	oncepts in an economic analysis - Economic models, time value of mon	ev: Ut	ility	rate
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		ost of electricity: Loss evaluation: Load management - Demand control tec	hnique	s. Lit	ility
		ost of electricity; Loss evaluation; Load management - Demand control tec and control system; HVAC and energy management; Economic justification		s; Ut	ility
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CO1	identify the energy policy and roles of energy managers.	Analyzing(K4)
CO2	enumerate the cost and load management on economic models.	Understanding (K2)
CO3	explain the energy management on demand side.	Understanding (K2)
CO4	describe the process of energy auditing.	Understanding (K2)
CO5	implement energy conservation aspects in industries.	Analyzing(K4)

- Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.
- Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, Fifth Edition, Reprint 2017.
- Anil Kumar, Om Prakash ,Chauhan Prashant Singh, "Energy Management: Conservation and Audits", CRC Press, 2020.
- Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.

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CO2	3	3	2	2	1	1
CO3	3	3	2	2	1	1
CO4	3	3	3	1	2	3
CO5	3	3	2	1	1	1



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Application of reactive power evolution algoristic formulation and optimal control; UNIT II Linear tracking Characteristics continuous system by stemponential and UNIT III CNN classificate decomposition appreciative control UNIT IV Filtering – Linear ime model – Estimation. UNIT V Filter problem	Itering and estimation techniques for power systems applications.		143	
Application of reactive power evolution algorithm and optimal control; UNIT II Linear tracking Characteristics continuous system by stems and the exponential and th	Kalman filter for power systems protection application.	+		
Application of reactive power evolution algorication and optimal control; UNIT II Linear tracking Characteristics continuous system by stems and the control optimal control; UNIT III CNN classificate decomposition and optimal control optimal control; UNIT IV Filtering – Linear tracking Characteristics continuous systems optimal and optimal control optimal control; UNIT III CNN classification optimal control; UNIT IV Filtering – Linear tracking CNN classification optimal control; UNIT IV Filtering – Linear tracking CNN classification optimal control; UNIT IV Filtering – Linear tracking CNN classification optimal control; UNIT IV Filtering – Linear tracking CNN classification optimal control; UNIT IV Filtering – Linear tracking CNN classification optimal control opti	NTRODUCTION			
Linear tracking Characteristics continuous system problem by stem exponential and UNIT III CNN classificate decomposition as predictive control UNIT IV Filtering – Linear ime model – E estimation. UNIT V K Filter problem	optimization, optimization techniques for emission dispatch of powerithm, optimization techniques for pole placement and state feed-back and forms of optimal control – Selection of performance measures; Neces ; State inequality constraints; Minimum time problem.	gorith	ms; Pr	oblen
Characteristics continuous system problem by stem exponential and UNIT III CNN classificate decomposition as predictive control UNIT IV Filtering – Lineatime model – E estimation. UNIT V Filter problem	INEAR QUADRATIC TRACKING PROBLEMS AND NUMERIC TECHNIQUES FOR OPTIMAL CONTROL problem – LQG problem; Computational procedure for solving optimal			9
CNN classificate decomposition a predictive control co	of dynamic programming solution – Dynamic programming applications – Hamilton Jacobi Bellman equation; Numerical solution of 2-posepest descent and Fletcher Powell method - Solution of Ricatti equations interactive methods.	int bo	undary	value
DISTRICT OF THE PROPERTY OF TH	MODEL DECOMPOSITION AND CONVOLUTIONAL NEURAL NETWORK	H		
Filtering – Lineatime model – Elestimation. UNIT V K. Filter problem	ation, CNN algorithm model decomposition techniques, appli and CNN based techniques for various power system fault diagnosis collers for power system for power system stabilizers.			
estimation. UNIT V K. Filter problem	ILTERING AND ESTIMATION		2172	9
Filter problem	ear system and estimation; System noise smoothing and prediction; Gau Estimation criteria; Minimum variance estimation; Least square estim			screte
	ALMAN FILTER			9
	and properties – Linear estimator property of Kalman filter, tin bility of filters, time filtered estimates and signal to noise ratio impro- Kalman filter for power system protection applications			and
	TOTAL			45

COCI	SE OUTCOMES	
At the e	nd of this course, students will be able to	BT Mapped (Highest Level)
CO1	describe the concept of optimization techniques for power systems.	Understanding (K2)
CO2	identify, formulate and measure the performance of optimal controllers for power systems.	Applying (K3)
CO3	explain the linear quadratic tracking problems and implement dynamic programming application for discrete and continuous systems.	Understanding (K2)
CO4	apply filtering and estimation techniques for power systems applications.	Applying (K3)
CO5	describe Kalman filter for power system protection application.	Understanding (K2)

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 Springer Verlag.
- Yong Hua Song, Johns Allen, Aggarwal Raj, 'Computational Intelligence Application to Power System', Springer Netherlands., Fourth Edition Reprint 2020.
- Dipu Sarkar, Chandan Kumar Chanda, "Computational Techniques for Power Systems Analysis", BS Publications / BSP Books 2020.
- Nagendra Singh, Sitendra Tamrakar, Arvind Mewada, Sanjeev Kumar Gupta, "Artificial Intelligence Techniques in Power Systems Operations and Analysis", Auerbach Publications 2023.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

Programme Outcomes PO's CO's PO₁ PO 2 PO₃ PO 4 PO 5 PO 6 CO₁ 2 1 CO₂ 2 3 3 3 CO₃ 2 3 2 CO₄ 2 2 3 1 1 2 2 2 3 CO5



	168 MACHINE LEARNING AND DEEP LEARNI	NG	3	0	0	3	
	SE OBJECTIVES	Maril To	r H	19/4			
To enab	ble the students to						
1	learn about the learning problem and algorithms.	rtië Inië e	T, H				
2	provide insight about neural networks.	aller modi		Ka	-		
3	know about the machine learning fundamentals and significance.	bout the machine learning fundamentals and significance.					
4	acquire knowledge about pattern recognition.	T 7 an	1 4				
5	apply deep learning algorithms for solving real life problems.		ll en	e a			
UNIT I	LEARNING PROBLEMS AND ALGORITHMS		Ivol	T me		9	
Various	s paradigms of learning problems; Supervised, semi-supervised an	d unsuperv	ised	algor	ithm	S.	
UNIT I	II NEURAL NETWORKS	John J. alb				9	
Differen	nces between biological and artificial neural networks - Typical a	rchitecture	, con	nmon	activ	vatior	
	sociative, Kohonen self organising maps, examples of feature map at descent, Boltzmann machine learning. MACHINE LEARNING – FUNDAMENTALS, FEATI			To j	H ₀		
UNIT I		RE SELE	CTI	ONS		9	
	AND CLASSIFICATIONS						
dimensi	ying samples - The confusion matrix, accuracy, precision, re ionality, training, testing, validation, cross validation, overfitting	g, under-fi	tting	the	data,	early	
dimensi stopping Classific clusterii	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating.	g, under-fi tion, dimention, multi	tting nsior clas	the a	data, redu	early	
dimensi stopping Classific clusterin	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI	g, under-fittion, dimension, multi	tting nsior clas	the mality	data, redu ssific	early ection.	
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dimensi stopping Classific clusterin UNIT I Feed f normali	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NIforward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers,	g, under-fittion, dimension, multi ETWORK in CNN, dropout, e	tting nsior clas	the mality	data, redu ssific	early eation, ation, batch	
dimensi stopping Classific clusterin UNIT I Feed f normali	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL Notes of the propagation detection, convolution layers, pooling layers, fully connected layers, the propagation of the propagatio	g, under-finition, dimension, multi- ETWORK in CNN, dropout, e	tting nsion class S opt	the mality ss classification is classification.	data, redu ssific ers, of CN	early eation, eation, batch	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Constructure of RNN Cell, LSTM and GRU, time distributed	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e GANS layers, g	nsior class S opt	the mality is classically coles of atting	data, redu ssific ers, of CN	early section, sation,	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoend	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Contraction of RNN Cell, LSTM and GRU, time distributed coders - Convolutional autoencoders, denoising autoencoders, values.	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e GANS layers, g	nsior class S opt	the mality is classically coles of atting	data, redu ssific ers, of CN	early eation, ation, batch Ns.	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoend	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Constructure of RNN Cell, LSTM and GRU, time distributed	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e GANS layers, g	nsior class S opt	the mality is classically coles of atting	data, redu ssific ers, of CN	early section, sation,	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoend	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Constructure of RNN Cell, LSTM and GRU, time distributed coders - Convolutional autoencoders, denoising autoencoders, value criminator, generator, DCGANs.	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e GANS layers, g	class opt characteristics	the chality is classical coder	data, redu ssific ers, of CN text	early early eation, eation, batch	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoend The disc	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Control of RNN Cell, LSTM and GRU, time distributed coders - Convolutional autoencoders, denoising autoencoders, variation, generator, DCGANs. SE OUTCOMES	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e. GANS layers, griational au	class opt class opt xamp	the mality is classical codes of the coder coder	data, redu ssific ers, of CN text	early eation, eation, batch	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoence The disc	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NUmber of the networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, value of RNN Cell, LSTM and GRU, time distributed coders - Convolutional autoencoders, denoising autoencoders, value criminator, generator, DCGANs. SE OUTCOMES end of this course, students will be able to	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e. GANS layers, griational au	tting nsior class opt energitoen AL P BT I	the mality is class class class class class class coder coder coder ERIC	data, redu ssific ers, of CN text rs; G	early section, sation,	
dimensi stopping Classific clusterin UNIT I Feed f normali UNIT V State, s Autoend The disc	ionality, training, testing, validation, cross validation, overfitting, regularization, bias and variance; Feature selection, normalizations - KNN, SVM, Decision trees, Naïve bayes, binary classificating. IV DEEP LEARNING: CONVOLUTIONAL NEURAL NI forward networks, activation functions, back propagation ization, convolution layers, pooling layers, fully connected layers, V DEEP LEARNING: RNNS, AUTOENCODERS AND Control of RNN Cell, LSTM and GRU, time distributed coders - Convolutional autoencoders, denoising autoencoders, variation, generator, DCGANs. SE OUTCOMES	g, under-fittion, dimension, multiset ETWORK in CNN, dropout, e. GANS layers, griational au	tting nsior class opt energitoen AL P BT I	the mality is class class class class class class coder coder coder ERIC	data, redu ssific ers, of CN text rs; G	early eation,	

CO3	acquaint with the pattern association using neural networks	Understanding (K2)
CO4	elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks	Understanding (K2)
CO5	construct different feature selection and classification	Learning the starfolder
	techniques and advanced neural network architectures such as	Understanding (K2)
	RNN, Autoencoders, and GANs.	

- J. S. R. Jang, C. T. Sun, E. Mizutani, "Neuro Fuzzy and Soft Computing A Computational Approach to Learning and Machine Intelligence", 2019, PHI learning.
- Ian Good fellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, ISBN: 9780262035613, 2016.
- Trevor Hastie, Robert Tibshirani and Jerome Friedman, "The Elements of Statistical Learning" Second Edition Reprint 2019.
- Shai Shalev-Shwartz and Shai Ben-David. "Understanding Machine Learning". Cambridge University Press. 2020.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

			Programme O	utcomes PO's	and the lands	
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	3 .	1	1	-	-
CO2	2	3	2	1	LINE DES	-
CO3	3	-	3	-	-	-
CO4	2	3	3	Uver and	Let I franci	-91 112
CO5	2	3	3	-		



		CLOUD COMPUTING	3	0	0	3
COURSE	OBJECTIVES	Taking beautiful and			B	
To enable	the students to					
1 kn	ow the principles o	f cloud computing.	mi les	n=J		
2 stu	dy the various clou	d service models.	17 70		-124	
3 un	derstand the basics	of virtualization.		Ditall		H
4 far	miliarize with the p	rogramming models available in cloud.	min' rei	19-01		
5 get	t an insight on some	e applications and prospects of cloud computing.	يدعا الأبق	JES.	Ŧ	
UNIT I	AN OVERVIE	CW Million pelast		Burnel		9
Cloud Co	mputing - Definiti	ion, motivation, characteristics; Past, present, and	d future	cloud	con	nputing
Issues wit	th cloud computir	chitecture; Cloud deployment techniques; Cloud ser ng, comparison between cloud computing and ociated with cloud computing, prospects and implica-	grid con			
UNIT II	CLOUD SERV	VICES	ur T			9
			The second secon	ploym		
UNIT III	VIRTUALIZA	ommunity cloud, hybrid cloud. ATION opportunities; Processor virtualization, memor	y virtu			9 storage
UNIT III Introduction virtualization virtualization	VIRTUALIZA on- Virtualization ion, network virtualization, full virtualization	ATION	alization	alizatio	on,	storage hes to
UNIT III Introduction virtualization	on- Virtualization ion, network virtualization, full virtualizations; From virtualization	opportunities; Processor virtualization, memor ualization, data virtualization, application virtu zation, para virtualization, hardware-assisted	alization	alizatio	on,	storage hes to
UNIT III Introduction virtualization	VIRTUALIZA on- Virtualization ion, network virtualization, full virtualization rs; From virtualization PROGRAMM and extended progration, Erlang; SORC ing models propose	opportunities; Processor virtualization, memori ualization, data virtualization, application virtualization, para virtualization, hardware-assisted vion to cloud computing – IaaS, PaaS, SaaS.	alization virtualization uce model g model	alization, appation; el, clo	Typud F	storage hes to pes of 9 Haskell; a; New
UNIT III Introduction virtualization	VIRTUALIZATION VIRTUALIZATION VIRTUALIZATION VIRTUALIZATION (Inc.)	opportunities; Processor virtualization, memoricularization, data virtualization, application virtualization, para virtualization, hardware-assisted violeto to cloud computing – IaaS, PaaS, SaaS. ING MODELS FOR CLOUD COMPUTING amming models for cloud - BSP model, map reduce ER – Object oriented programming; Programming	alization virtualization uce model g model	alization, appation; el, clo	Typud F	storage hes to pes of 9 Haskell; a; New
UNIT III Introduction virtualization virtualization virtualization virtualization virtualization virtualization virtualization unit in the programm application unit virtualization unit v	VIRTUALIZA on- Virtualization ion, network virtualization, full virtualization rs; From virtualization PROGRAMM and extended progration, Erlang; SORC ing models propose ins. APPLICATIO clications - Engine cloud prospects; Im	opportunities; Processor virtualization, memoricalization, data virtualization, application virtualization, para virtualization, hardware-assisted violento cloud computing – IaaS, PaaS, SaaS. ING MODELS FOR CLOUD COMPUTING amming models for cloud - BSP model, map reduce the computing of the cloud; Orleans; BOOM and bloom; Grid based for cloud; Orleans; BOOM and bloom; Grid based of the cloud; Orleans; BOOM and B	uce model g model atch - Sin	alization, appation; el, clo s in A	Ty ud F	storage hes to pes of 9 laskell; a; New for grid 9 Cloud
UNIT III Introduction virtualizate thypervisor UNIT IV Existing a Multi ML programm application UNIT V Cloud application gaming; C in emergin	VIRTUALIZATION VIRTUA	opportunities; Processor virtualization, memoricalization, data virtualization, application virtualization, para virtualization, hardware-assisted violento cloud computing – IaaS, PaaS, SaaS. ING MODELS FOR CLOUD COMPUTING The amming models for cloud - BSP model, map reduce the cloud; Orleans; BOOM and bloom; Grid bath of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and IT profe	uce model g model atch - Sin	alization, apparation; el, clo s in A mple A	Typud FanekaAPI f	storage hes to pes of 9 laskell; a; New for grid 9 Cloud
UNIT III Introduction virtualization	VIRTUALIZATION VIRTUA	opportunities; Processor virtualization, memoricalization, data virtualization, application virtualization, para virtualization, hardware-assisted violento cloud computing – IaaS, PaaS, SaaS. ING MODELS FOR CLOUD COMPUTING The amming models for cloud - BSP model, map reduce the cloud; Orleans; BOOM and bloom; Grid bath of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and the IT in the topics in cloud computing; The future of the cloud on IT professionals and IT profe	ice model g model atch - Sin sonal apadustry; ads.	alization, apparation; el, clo s in A mple A	Typud FanekaAPI i	storage hes to pes of 9 Haskell; a; New For grid 9 Cloud hputing

	computing.	
CO2	describe the cloud services offered by the companies.	Understanding (K2)
CO3	explain the concept of virtualization.	Understanding (K2)
CO4	discuss the suitability of each programming model to different kinds of application.	Understanding (K2)
CO5	identify the areas of application and explore future prospects.	Understanding (K2)

- 1. K. Chandrasekaran, "Essentials of Cloud Computing", CRC press, 2020
- RajkumarBuyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2019.
- 3. Dan C. Marinescu, "Cloud Computing: Theory and Practice, Morgan Kaufmann, 2019.
- 4. San Murugesan, Irena Bojanova, "Encyclopedia of Cloud Computing", Wiley-IEEE press, 2016.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's					
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	1	2	1			-
CO2	1	1	2			-
CO3	2		1			-
CO4	1	2	1			-
CO5	3	3	1		-	-



To enab	infer breakdown me	sulating materials used in power system.				10	
1 2	know the various in	sulating materials used in power system.					
2	infer breakdown me	sulating materials used in power system.					
-					7-1	914.1	31
2		chanism of solid, liquid and gaseous dielectrics.	and the same				
3	interpret the high vo	ltage generation methods and measurements			Al ex		
4	construe insulation	testing of electrical equipments.					
5	understand the vario	ous Non-destructive testing in high voltage.	-//-	Ja L			
UNIT I	INSULATIN	G MATERIALS IN POWER SYSTEM		a la			9
Review	of insulating mat	erials gases, vacuum, liquids and solids; Ch	aracteri	zation	n of	insul	ation
conditio	on - permittivity, ca	pacitance, resistivity and insulation resistance,	lielectri	diss	sipatio	on fa	ctors;
Partial	discharges sources.	forms and effects, ageing effects, electrical	breakd	lown	and	oper	ating
stresses	, standards relating t	o insulating materials.					
UNIT I	BREAKDOV DIELECTR	WN MECHANISMS OF SOLID, LIQUID AN	D GAS	EOU	S		9
Introdu	The state of the s	ystems used in high voltage power apparatus -	Breakd	own	mech	anisı	ns of
solid, li	quid, gas and vacuu	m insulation.					
UNIT I		THODS OF GENERATION AND MEASURE	MENT	OF '	FEST	,	
	HIGH VOL						9
impulse measure		divider circuits; Digital storage oscilloscope for	impulse	volt	age a	nd cu	rrent
UNIT I	V INSULATIO	ON TESTING OF ELECTRICAL EQUIPME	NTS		-		9
		e testing - Testing of distribution and pov		sforn	ners	: Vo	
transfor	mers; Current trans	formers; Bushings; Overhead line and substation t breakers and isolators; IEC and Indian standard	n insulat				
UNIT V	V NON-DEST	RUCTIVE TESTING	TH				9
Insulati	on resistance measu	rement- Measurement of tan delta and capacita	nce of d	ielec	trics;	Grou	nded
objects	like transformers	and alternators; Measurement of PARTIAL	discha	rges;	Loc	ation	and
measure	ement of discharges	in electrical equipment; Dissolved gas in oil mea	asureme	nt.			
			TOTA	AL P	ERIC	DS	45
	SE OUTCOMES end of this course, st	udents will be able to	0		Mapp		
CO1	describe the vario	us insulating materials used in power system.	(1		est Lo		(K2)
CO2		wn mechanism of solid, liquid and gaseous	- 3				
	dielectrics.	u .		Olid	erstar	idilig	(KZ)

CO3	explain the high voltage generation methods and measurements.	Understanding (K2)
CO4	evaluate insulation testing of electrical equipments.	Understanding (K2)
CO5	describe the various Non-destructive testing in high voltage.	Understanding (K2)

- Adrianus, J. Dekker, "Electrical Engineering Materials", Prentice Hall of India Pvt. Ltd., New Delhi, 2018.
- Kuffel, E. and Zaengl, W.S., "High Voltage Engineering Fundamentals", Pergamon Press, Oxford, New York 2018.
- Naidu, M.S. and Kamaraju, V., "High Voltage Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2019.
- Gallagher, T.J., and Permain, A., "High Voltage Measurement, Testing and Design", John Wiley Sons, New York, 2020.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

	Programme Outcomes PO's							
CO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6		
CO1	2	1	3	3	2	2		
CO2	3	2	3	3	2			
CO3	3	2	3	3		2		
CO4	3	2 .	3	3	2	2		
CO5	3	2	3	3	2	2		



PPS2	3901		AL	TERNA	TE EN	ERGI SC	JURCES		3	0	0	3
cou	RSE OBJE	CTIVES				Making I	19 19 50	ne obel				M)
To en	nable the stu	dents to										
1	know abo	ut solar radia	iation	and its n	neasuren	nent system	n.				П	10
2	learn abo	ut the compo	onents	of wind	energy	conversion	n system.		HILL BY			
3	understan	d the concep	pt of g	eotherm	al energy	y and its c	onversion	process.		33/0	i)(I)	
4	acquire k	nowledge ab	bout bi	omass e	nergy an	d its class	ifications.	nema X-m	UF C	0 1		
5	identify d	ifferent ener	rgy so	urces an	d workin	ng principl	es.			910	S	
UNIT	r I	SOLAR R	RADIA	TION	AND IT	S MEASI	JRMENT		V North			9
meası	urements- P	of beam ra	rs, pyr	anomete		tion geor	netry; Loc	al solar	time;	Solar	radi	ation
UNIT	rII	WIND EN	ERG	Y			11 15 15	A jorlani?	174	and it		9
UNIT	гш	n; Performan	nce of	wind ma	RGY	ngri 6	is (200)	ources: Ge	o pres	sured	resou	
UNIT Estim Hot d	nates of geoti dry rock reso	GEOTHEI hermal power ources petro-tos, positive dis	er, Nat- therm	L ENEI tural geo al system	achines. RGY othermal ms; Primachines,	fields; Ge e movers	othermal s	mal energ	y com	version	- Im	rces;
UNIT Estim Hot d reacti	nates of geoti dry rock reso ion machines or plants; App	GEOTHEI hermal power burces petro-tos, positive displications of	er; Nati	L ENEI tural geo al system emient m	achines. RGY othermal ms; Primachines,	fields; Ge e movers	othermal s	mal energ	y com	version	- Im	rces;
UNITEStime Hot de reaction power UNITESTER	nates of geother rock resonant rock rock rock rock rock rock rock rock	GEOTHEI hermal power purces petro-tos, positive displications of BIOMASS	er; Nate therm isplace of geoth	wind ma LENEI tural geo al system ement m ermal er	achines. RGY othermal ms; Prime achines, nergy.	fields; Ge e movers impulse r	othermal s for geother nachine; I	mal energ	y conv	version	eothe	pulse pulse ermal
Estime Hot de reaction power UNIT Bioma used for obtain	nates of geotion machines or plants; App	m; Performant GEOTHEI hermal power ources petro-tos, positive dis- plications of BIOMASS on technology generation; Softom bio mass	er; Nathermann displaced f geother sense of Sense of Selections.	tural geo al systement mermal er CRGY Wet pro	othermal ms; Prima achines, nergy.	fields; Ge e movers impulse r	othermal s for geother nachine; I	mal energ	lection logas j	version n for g	eothe Mate	pulse ermal 9 erials
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CO1	describe the solar radiation and its measurement.	Understanding (K2)
CO2	elucidate the performance of wind energy conversion system.	Applying (K3)
CO3	interpret energy conversion process for acquiring geothermal energy.	Understanding (K2)
CO4	enumerate the biomass energy in a useful way.	Understanding (K2)
CO5	describe the components of energy sources ocean, tidal and hydro.	Understanding (K2)

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CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific
Outcomes PSO's

Programme Outcomes PO's							
PO 1	PO 2	PO 3	PO 4	PO 5	PO 6		
2	1	3	3	in emiliares pro-	2		
3	2	3	3	2	2		
3	2	3		2	2		
3	2	3	3	2	-		
3	2	3	3	2	2		
	A-1-4-	2 1	PO 1 PO 2 PO 3 2 1 3	PO 1 PO 2 PO 3 PO 4 2 1 3 3	PO 1 PO 2 PO 3 PO 4 PO 5 2 1 3 3 -		

