Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)



Course Contents (Syllabus) for

Final Year B. Tech (Electrical Engineering) Sem. VII to VIII

AY 2020-21

ODD Semester

Professional Core (Theory) Courses

]	litle of	f the Co	urse:	Power	System	m Har	monic	s and	FACT	S			L	Т	P)	Cr
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ł	Pre-Re	quisite	Cours	es: Ba	sic Ele	ctrical	Engin	eering	(EE 10	01), Po	wer Ele	ctronic	2S				
]	ſextbo	oks:															
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	MSE.	Assessr	nent is	based	$on 50^{\circ}$	% of co	ourse c	ontent	(Norm	allv fi	rst three	modu	les)	oc u	scu IU	61 IV	∟ ∠]
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(Course	Conter	nts:														
	Modu	le 1: In	troduc	ction to	o Powe	er Qua	lity									Η	rs.

Introduction, Electromagnetic phenomena – Transients, Long and short duration voltage variations, wave form distortion.	4
Module 2: Fundamentals of Harmonics	Hrs.
Representation characteristic harmonics, Harmonic indices Harmonic sources-6&12 pulse	
related harmonics, harmonic effects on power apparatus and on measurements, interference	6
with communications	
Module 3: Harmonic Mitigation Techniques	Hrs.
Shunt passive filters, types, Design considerations and illustrative examples, Active filters:	
types, current and voltage source active filters, shunt, series & Hybrid active filters, Detuned	6
filters.	
Module 4: Reactive-Power Control in Electrical Power Transmission	Hrs.
Power flow in AC Systems. Definition of FACTS. Power Flow Control. Constraints of	
maximum transmission line loading. Benefits of FACTS Transmission line compensation:	6
Uncompensated line, shunt compensation. Series compensation, Phase angle control.	
Module 5: Principles of Conventional Reactive-Power Compensators	Hrs.
The Saturated Reactor (SR), The Thyristor-Controlled Reactor (TCR), Operating	
Characteristics of a TCR, The Thyristor-Controlled Transformer (TCT), The Fixed Capacitor-	
Thyristor-Controlled Reactor (FC-TCR), The Mechanically Switched Capacitor-Thyristor-	10
Controlled Reactor (MSC-TCR), The Thyristor-Switched Capacitor (TSC), The Thyristor-	10
Switched Capacitor-Thyristor-Controlled Reactor (TSC-TCR), A Comparison of Different	
SVCs.	
Module 6: The Thyristor-Controlled Series Capacitor (TCSC)	Hrs.
Series Compensation, The TCSC Controller, Operation of the TCSC, Analysis of the TCSC,	8
Capability Characteristics, Harmonic Performance, Losses.	0
Module wise Measurable Students Learning Outcomes :	
After the completion of the course the student will be able to:	
1. Comprehend fundamentals of Power Quality problems.	
2. Explain the concept of harmonics and related problems.	
3. Design harmonic mitigation systems to counter power quality problems.	
4. Explain basic concepts of FACTs devises and controllers.	
5. Explain the characteristics, applications and modelling of shunt FACTS controllers.	
6. Explain the characteristics, applications and modelling of series FACTS controllers.	

Title of															
a	the Co	urse: H	IVDC	Trans	smissio	n						L	Т	Р	C
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Pre-Re	quisite	Course	es: Pov	ver Ele	ectronic	cs, Pov	ver Sys	stem E	nginee	ring	•				
Textbo	oks:														
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<u>2.</u> E	E.W. Kir	nbark,	"Direc	t Curr	ent Tra	insmiss	sion", '	Win pu	blishe	ſ .					
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Course Contents:	
Module 1: Introduction to HVDC Transmission Technology	Hrs.
Comparison of EHVAC and HVDC Transmission, types of HVDC transmission systems,	(
components of HVDC transmission system.	0
Module 2:Analysis of HVDC converter	Hrs.
Different modes of valve operation, o/p voltage waveforms and D C voltage in rectification,	6
and inverter operation, valve voltages, equivalent electrical circuit, converter charts.	0
Module 3:HVDCTS control features	Hrs.
Control modes, control schemes and their comparisons, energization and de-energization of	6
bridges, starting and stopping of D C link.	0
Module 4: Faults and over-voltages	Hrs.
Converter mal-operations, commutation failure, over-voltages in HVDCTS, protection of	(
converters, D C reactor and damper circuits.	0
Module 5: Harmonics and their suppression in HVDCTS	Hrs.
Harmonic analysis, filter design, minimum cost tuned A C filters, reactive power	(
requirements.	0
Module 6: Multi terminal HVDCTS	Hrs.
Series and parallel MTDCTS, their control, introduction to HVDC light, recent trends in	
HVDCTS.	Ø
Module wise Measurable Students Learning Outcomes :	

After completion of the course students will be able to:

- 1. Explain need of HVDC and layout.
 - 2. Analyze HVDC converters, and derive its equivalent circuit. They will be able to prepare and read converter charts of HVDCTS.
 - 3. Classify different control modes of HVDCTS, and will be able to compare these to control schemes. They will be able to explain energization and de-energization and starting and stopping procedures for HVDC links.
 - 4. Discuss various faults and causes of over-voltages. They will be able to suggest various methods to protect HVDCTS.
 - 5. Classify causes of harmonics and will be able to design cost effective filter for harmonics suppression which will meet reactive power requirements of the system as well.
 - 6. Discuss different types of Multi terminal HVDC system and compare them. They will be able to understand various control aspects of MTDC system.

Title of	f the Co	urse: S	Solar a	nd Wi	ind Po	wer G	enerat	tion			Ι	_	Т	Р		Cr
Course	Code:	3EL40	3									3	0	0		3
Pre-Re	quisite	Course	es: Pov	ver Sys	stem E	nginee	ring ar	nd Pow	er Elec	ctronics						
Textbo	oks:															
1.	Boyle, O	Godfre	y, "Rer	newabl	e Ener	gy", (2	2 nd edit	ion), C	0xford	Univers	ity Pre	ss, 200)4.			
2.	G.S.Sav	vhney,	"Non-	Conve	ntional	Resou	irces o	f Energ	gy", PH	H Publi	cation	2012.				
Refere	nces:	T 1	** 7*	1 5	C			G	11111							
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3. 1	Fo acqua	int stu	dents v	vith po	ssible	storage	e syste	ms in r	enewal	ble gene	eration.					
4. I	ntroduce	e recen	t trend	s in rei	newabl	e energ	gy syst	em to	student	ts.						
Course	e Learni	ng Ou	tcome	5:												
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	& concentrating collectors.	
	Module 3: Solar Photovoltaic Energy Conversion & Utilization	Hrs.
	Configuration of PV power generation system- off-grid system & grid-connected PV system,	
	single stage & two stage converters for power transfer, single phase & three phase inverters for	6
	PV, control of grid connected PV system.	
	Module 4: Wind Resource Assessment	Hrs.
	Power available in wind, wind turbine power & torque characteristics, types of rotors,	
	characteristics of wind rotor, local effects, wind shear, turbulence & acceleration effects,	
	measurement of wind, wind speed statistics, statistical model for wind data analysis, energy	0
	estimation of wind regimes, capacity factor, aerodynamics of wind turbines, airfoil, lift & drag	9
	characteristics, power coefficient & tip speed ratio characteristics, electrical generator	
	machines in wind energy systems.	
	Module 5: Storage and Fuel Cell Technologies	Hrs.
	Introduction, need for storage for RES, traditional energy storage system- battery, fuel cell,	1
	principle of operation, types of fuel cell.	-
	Module 6: Emerging Trends in Renewable Energy	Hrs.
	Introduction to SG, SG in Indian context, architecture of SG, advantages & disadvantages, key	
	challenges for SG, SG technologies, AMI, PMU, WAMS, standards & codes for grid	6
	integration of DG systems.	
]	Module wise Measurable Students Learning Outcomes :	
1	After completion of the course students will be able to:	
	1. Explain the various renewable energy sources.	
	2. Compare the equivalent circuit of PV cell and its modeling.	
	3. Explain the grid-connected PV system.	
	4. Explain wind power generation & its mechanical aspects.	

- 5. Describe energy storage systems.
- 6. Explain the smart grid, recent trends in renewable system & standards for grid integration.

Professional Core (Lab) Courses

Title of the Course: Power System Harmonics and FACTS Lab	L	Т	Р	Cr
Course Code: 3EL451	0	0	2	1
Pre-Requisite Courses: Basic Electrical Engineering (EE 101), Power Electro	onics			
Textbooks:				
 Roger C. Dugan, Mark F. McGranton and H. Wayne Beety, "Electric McGraw Hill. 	cal Pow	ver Sys	tems Qı	uality"
2. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor - Based FACTS	S Contr	ollers	for Ele	ctrical
Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.				
References:				
1. George J. Wakileh, "Power System Harmonics - Fundamentals, Springer	Analy	sis &	filter D	esign"
2. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribut	ion", N	ew Age	e Interna	ational
(P) Ltd., Publishers, New Delhi, Reprint, 2008.				
Course Objectives :				
		T 1		

- 1. This course is intended to demonstrate Power Quality issues and their solutions. It also imparts skills to design harmonic filtering system suitable for particular application in power systems.
- 2. It imparts fundamental knowledge to model Series and Shunt FACTs devises and controllers. It develops the ability to identify suitable FACTS devises for the customized power system application.

Descriptor

Applying

Applying

Synthesis

Course Learning Outcomes: CO After the completion of the course the student will be able to Bloom's Cognitive level **CO1 Identify** power quality problems and its solutions. 3 3 **CO2** Experiment on FACTs devises to evaluate the performance based on analyzed data. **CO3** 6 Design suitable harmonic filtering systems for particular

application and analyze the results. **CO-PO** Manning ·

	Tappi	<u>"5</u> •												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1												
CO2				3										
CO3			2											

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE. IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
I A 1	Lab activities,	Lab Course Faculty	During Week 1 to Week 4	25
LAI	attendance, journal	Lab Course Faculty	Submission at the end of Week 5	23
I A2	Lab activities,	Lab Course Faculty	During Week 5 to Week 8	25
LAZ	attendance, journal	Lab Course Faculty	Submission at the end of Week 9	23
Ι Δ 2	Lab activities,	Lab Course Feeulty	During Week 10 to Week 14	25
LAS	attendance, journal	Lab Course Faculty	Submission at the end of Week 14	23
Lob ESE	Lab Performance and	Lab Course feaulty	During Week 15 to Week 18	25
Lau ESE	related documentation	Lab Course faculty	Submission at the end of Week 18	23

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

- 1. Classification of Power Quality Disturbances.
- 2. Analysis of Power Component definitions in single phase circuits: linear and distorted current condition.
- 3. Analysis of Power Component definitions in single phase circuits: Nonlinear load.
- 4. Analysis of Power Component definitions in single phase circuits: Non Sinusoidal supply and Nonlinear load.
- 5. Illustrate the understanding of harmonic sources and their distortion levels.
- 6. Predict the parallel resonance frequency and solve for the magnified currents and voltages in the circuit.
- 7. Design of Single Tuned Harmonic Filter for mitigation of Harmonics.

8. Simulate series and shunt FACTs controllers for mitigation of Power Quality problems.

Computer Usage / Lab Tool: MATLAB

Title of the Course: Proj	ect I	L	Т	Р	Cr
Course Code: 3EL491		0	0	8	4
Pre-Requisite Courses:					
Textbooks: Suitable book	s based on the contents of the project selected.				
References: Suitable bool	ks based on the contents of the project selected and	research	n papers	s from r	eputed
national and international	journals/conferences.				
Course Objectives:					
1. To acquire the skill	s of electrical, electronic circuit design and mechanic	cal assei	nbly.		
2. To develop the skill	s of analysis and fault diagnosis of the electrical, ele	ctronic	circuit	and	
mechanical assemb	y as per design.				
3. To test the electrica	l, electronic circuit and mechanical assembly.				
Course Learning Outcor	nes:				
		D	1 2	a	

CO	After the completion of the course the student will be able to	Bloom's Cognitive			
		level	Descriptor		
CO1	Analyze and infer the reference literature/ research papers critically and efficiently.	4	Analyzing		
CO2	Decide the model of the project.	5	Evaluating		
CO3	Construct the project and assess the performance of the project.	6	Creating		
CO4	Write and Present the report of the project.	6	Creating		

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1												3	3	3
CO2			3						3		3			
CO3								3					3	3
CO4										3				

Assessment:

There are four components of project assessment, LA1, LA2, LA3 and Project ISE.

Assessme	Based on	Conducted by	Conduction and Marks	Marks
nt			Submission	
LA1	Project Topic Selection and Literature Review	Project Panel	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Simulation / Basic Project design	Project Panel	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Software /Hardware Implementation	Project Panel	During Week 10 to Week 14 Submission at the end of Week 14	25
Project ISE	Presentation, Project report submission	Project Panel	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.ISE is based on performance of student in project reports, demonstration, presentation, oral, etc. The project guide/panel shall use at least two assessment tools as mentioned above for ISE.

Course Contents:

- 1. Students may visit to nearby industry for the study of problems.
- 2. Prepare the problem statement and design the Simulations/ Hardware.
- 3. Analyze the performance of project and results to meet desired specifications.
- 4. Students should maintain a project log book containing weekly progress of the project.
- 5. Project report should be submitted along with soft copy (with code, PPT, PDF, Text report document & reference material) at the end of semester.

Module wise Measurable Students Learning Outcomes:

It is expected that students should be able to analyze the problem, work on hardware circuits and prepare the report.

Computer Usage / Lab Tool:

Professional Elective (Theory) Courses

Title of	f the Co	urse:	Advan	ced Po	ower H	Electro	nics					L	Т	P		Cr
Course	Code:	3EL41	1									3	0	0		3
Pre-Re	Pre-Requisite Courses: Power Electronics															
Textbo	Textbooks:															
1.	1. M. H.Rashid, Power Electronics: circuits devices and applications, Pearson Education, Third edition.															
Refere	nces:															
1.	1. B. K. Bose, Modern Power Electronics & AC drives, PHIPL, New Delhi.															
2.	M. B. Pa	atil, V.	Rama	yanan	and V.	T. Ra	nganat	han, Si	mulati	on of Po	ower E	Electro	onics o	circui	ts,	
2	Narosa publication.															
J. Course	Object		ion pa	Jers.												
	This cou	irce in	tands to	n nrovi	ide adı	anced	knowl	edre o	f diffe	rent nou	ver ele	octron	ic con	vorto	rc r	multi_
1.	level inv	verters	and rea	sonant	conve	rters	KIIOWI	cuge 0	I unit.	rent pow				vente	13, 1	iiuiti-
2	It is aim	ed to	imnart	ekille	of ana	lveie f	or diff	erent t	whee o	f advanc	red co	nvert	erc an	d shu	int e	active
2.	n is and nower fi	lters	impart	5K1115	or and	1y515 1	or unit		ypes o			nivert		u shu	111t t	
3	Make th	e stud	ents ac	auaint	ed wit	h conti	rol stra	tegies	of diff	erent tvi	nes of	adva	nced (ronve	erter	rs and
5.	shunt ac	tive po	ower fil	lters.			ior stru	.005105	or uni	erent ty	005 01	uuvu	neeu v		101	5 und
Course	Learni	ng Ou	tcomes	5:												
CO	After t	he cor	npletic	on of tl	he cou	rse the	e stude	ent will	l be ab	le to		Blo	om's	Cogn	itiv	e
												level		Descr	ipto	or
CO1	Disting	uish (configu	iration	and v	vorkin	g of di	ifferent	advar	nced por	wer	2	Ur	derst	and	ing
	electro	nic cor	verter	s.			6			F P						8
CO2	Analyz	e diffe	erent ac	lvance	d pow	er elec	tronic	conver	ters an	d system	ns.	4		Analy	zin	g
CO3	Evalua	nte pe	rforma	nce of	f diffe	rent p	ower o	electro	nic sv	stem us	ing	5	I	Evalu	atin	g
	power	electro	onic dev	vices a	nd con	verters	5.				8	-				0
CO-PC) Mappi	ng :														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12 P	SO1	PS	02
CO1	1	2														
CO2		2														
CO3			2		1											
					•	•						•				
Assessi	nent:															
Two co	mponen	ts of I	n Sem	ester E	Evaluat	tion (IS	SE), O	ne Mic	1 Seme	ester Ex	amina	tion ((MSE)) and	one	e End
Semest	er Exam	inatior	n (ESE)) havin	ig 20%	, 30%	and 50	% wei	ghtage	respect	ively.		. ,			
		A	ssessn	nent	0				0 0	•	Mar	ks				
			ISE 1	[10					
			MSE								30					
			ISE 2	2							10					
			ESE								50					
ISE 1	and IS	E 2 a	are bas	ed on	assig	nment.	oral,	semin	ar, tes	t (surpr	ise/de	clare	d/quiz), an	d g	roup
discus	discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]															
MSE:	Assessn	nent is	based	on 50%	6 of co	ourse co	ontent	(Norm	ally fir	st three	modu	les)				
ESE:	Assessn	nent is	based	on 100)% cou	irse co	ntent v	vith70-	80% v	veightag	e for	course	e cont	ent (n	orn	nally
last th	ree mod	ules) c	overed	after N	MSE.											
Course	Conten	ts:														L
Modu	le 1:PW	'M rec	tifiers												Н	rs.
Advan	tages &	disac	lvantag	ges of	three	phase	thyrist	tor con	verter	, PWM	conv	erters	work	ing,		
	0		2	-		•	5			-				<i>U</i> ,	<u> </u>	I
				Fina	al Yea	r B. Te	ech. (El	lectrica	l) for 2	2020-21						

types, Control of PWM rectifiers, analysis and application	6
Module 2:Multilevel inverters	Hrs.
Three phase two level inverter, Multilevel inverter, Types: Diode clamp multilevel inverter,	
flying capacitor multilevel inverter, cascaded multilevel inverter, applications of multilevel	8
inverters, comparison of multilevel inverter. Control method: sinusoidal PWM, selective	Ŭ
harmonic elimination, carrier PWM, space vector PWM.	
Module 3:Resonant pulse inverters	Hrs.
Series resonant inverter with unidirectional and bi-directional switches, parallel resonant	
inverters, voltage control of resonant inverters, zero current and zero voltage switching	8
resonant converters, two-quadrant ZVS resonant converters, resonant DC link inverters	
Module 4:High power factor converters	Hrs.
Need of HPFC, converters employing Line commutation and forced commutation, Single phase	
active PFC, analysis of single phase boost rectifier, Voltage doubler PWM rectifier, Three	
phase PFC circuits.	0
Module 5: Matrix Converters and Z source inverters	Hrs.
Topology, working and control methods of Matrix converters, Various circuit topologies and	6
control of Z source inverter, Application of Z source in induction motor control	U
Module 6:Active power filters	Hrs.
Power Quality Issues due to power Electronics, Introduction to active power filter, types of	
active power filters overall control of shunt active power filter, harmonic compensation &	6
reactive power compensation	
Module wise Measurable Students Learning Outcomes:	
After completion of the course students will be able to:	
1. Explain the PWM converters, their advantages and applications.	
2. Control the multilevel inverters.	
3. Design and simulate resonant converters.	
4. Grasp the advantages of high power factor converters.	
5. Simulate the z-source inverter.	
6. Design active filter for non-linear load.	

l'itle of	t the Co	urse: I	Process	s Cont	rol							,]	Ľ	P	Cr
Course	e Code: 3	3EL41	2								3	()	0	3
Pre-Re	equisite	Course	es:	_	_	_	_	_	_					_	
Textbo	oks:														
1.	George Prentice	Stepha -Hall o	anopou of India	llos, "(a, 1 st E	Chemio dition	cal Pro 1984.	ocess (Control	- An	introdu	ection to) Theo	ry a	nd Pra	actice"
Refere	nces:		r 1.		~		-				~		,		
1.	Thomas Perform	E. N ance 2	larlın, 2 nd Edi	"Proc tion"	ess Co Mc Gr	ontrol aw Hil	- Des I publi	sign Pi	rocesse	es and	Contro	l Syste	em f	for D	ynami
2.	F.G. Sh	inskey	/, "Pro	ocess	Contro	ol Syst	em –	Appli	cation,	Desig	n and	Tuning	g", I	McGra	aw-Hil
3.	Publicat Curtis D	ion, 3 ^r). John	^d Editions (*1)	on, 198 Process	38. 5 Cont	rol Ins	trumer	itation	Techn	ology",	7 th Edit	tion, P	earso	on Edu	cation
	7 th Editi	on. 20	03.							0.7					
Course	e Object	ives :													
1.	This cou	irse int	ends to	o provi	de bas	ics for	mathe	matica	l mode	l of the	process				
2.	It impar	ts the	knowl	ledge o	of vari	ous ty	pes of	contro	ollers f	for sing	le loop	and n	nulti	loop	contro
3	It provid	les ove	er view	v of ad	vanceo	1 contr	ollers	used ir	n nroce	ess cont	rol and	multiv	ariat	ole pre	dictiv
5.	control.			v or au	vanced	i conti	Uners	useu n		iss cont		munuv	anac	ne pre	uicuv
Course	e Learni	ng Ou	tcome	s:											
CO	After t	he con	npletio	on of t	he cou	rse the	e stude	ent will	l be ab	le to		Bloc	om's	Cogn	itive
												level]	Descri	ptor
CO1	Produ	ce the	models	s of ind	lustrial	proce	sses.					3		Apply	ing
CO2	Analyz	the p	problei	ms ass	ociated	l with	open l	oop an	d close	e loop p	process	4	4	Analy	zing
	control	syster	n.												
CO3	Evalua advanc	ite the ed con	perfo	rmance s.	e of pi	rocesse	es with	i vario	us con	vention	al and	5	I	Evalua	ating
CO4	Design	the	proce	esses	with	variou	is cor	ventio	nal a	nd ad	vanced	6		Creat	ing
	control	lers.	1												U
CO-PC) Mappi	ng :													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS	01 P	PSO2
CO1	1	2													
CO2		2													
CO3		2													
CO4			2												
Assessi	ment:														
Two co	omponen	ts of I	n Sem	ester E	Evaluat	tion (IS	SE), O	ne Mio	d Seme	ester Ex	aminati	on (M	SE)	and o	ne En
Semest	er Exam	inatior	n (ESE)) havin	g 20%	, 30%	and 50	% wei	ghtage	respect	ively.				
		A	ssessn	nent							Marks	6			
			ISE 1	1							10				
			MSE	3							30				
	ISE 2 10														
			ESE								50				
ISE 1	and IS	E 2 a	re bas	sed on	assig	nment,	oral,	semin	ar, tes	t (surp	rise/dec	lared/q	uiz),	and	group
discus	sion.[Or	ne asse	ssment	t tool p	er ISE	. The a	issessn	nent too	ol used	for ISE	E 1 shall	not be	used	d for I	SE 2]
MSE:	Assessm	nent is	based	on 50%	6 of co	ourse co	ontent	(Norm	ally fir	st three	module	es)			
ESE:	Assessn	nent is	based	on 100)% cou	irse co	ntent v	vith70-	80% v	veightag	ge for co	ourse c	ontei	nt (noi	rmally
last th	ree mod	ules) c	overed	after N	MSE.										
Course	e Conten	its:													
Modu	le 1:Int	roduct	tion to	Proce	ss Con	trol									Hrs.
mouu														1	

Introduction, Design aspects of a process control system, Hardware for a process control system. Mathematical modeling and analysis of processes, development of a mathematical model,	6
Modeling considerations for control purposes, the input-output model, degree of freedom.	
Module 2: Modelling of Process	Hrs.
Computer Simulation and linearization of nonlinear systems, Transfer functions and the Input-	
output models. Dynamic behavior of first-order systems, second-order system and higher order	5
systems.	
Module 3: Feedback Control of Process	Hrs.
Elements of feedback control system, types of feedback controllers, sensors, Transmission lines,	
final control elements. Dynamic behavior of feedback-controlled process, Effect of proportional	
(p) control, Integral (I) control and derivative (D) control on the response of controlled process,	0
effect of composite control actions.	
Module 4: Multi Loop Control	Hrs.
Feedback control of system with large dead time or inverse response, processes with large Dead	
time, Dead time compensation, and control of systems with inverse response. Control systems	
with multiple loops, cascade control, split-range control, feed forward control, Ratio-control,	7
problem in designing feed forward controllers, practical aspects on the design of feed forward	
controllers, $F/F - F/B$ control.	
Module 5: MIMO Process	Hrs.
Multi-input, multi-output processes, degree of freedom and number of controlled and	
Manipulated variables, interaction and decoupling of control loops, relative gain array and	
selection of loops, design of non-interacting control loops. Overview of modern control	6
methodologies: PLC, SCADA, DCS, Adaptive control, variable structure control.	
Module 6: Centralized Multivariable Control	Hrs.
Multivariable model predictive control, single-variable dynamic matrix control (DMC)	
algorithm, multivariable dynamic matrix control, internal model control, smith predictive, model	
predictive control, process model based control, implementation guidelines. Process control	0
design: sequence of design steps, statistical process control.	
 Module wise Measurable Students Learning Outcomes:	
After completion of the course students will be able to:	
1. Describe model the Process Control system.	
2. Evaluate performance of process by conventional control techniques.	
3. Analyze the process with conventional controllers for process control.	
4. Analyze the process the advance controllers for process control.	c
5. Analyze the controllers for multi-input multi-output process and evaluate the performance of	ot multi-

- input multi-o ու բ ιp 6. Design advance digital controller based on model of the process.

Title of the Course: Power System Operation and Control	L	Т	Р	Cr
Course Code: 3EL413	3	0	0	3

Pre-Requisite Courses: Power System Engineering, Power System Analysis and Stability, Control System Engineering, Power Electronics.

Textbooks:

1. Power System Analysis: Operation and Control by S. Sivanagaraju Pearson Education India, 2009 **References:**

- 1. Power System Operation and Control Robert Herschel Miller, McGraw Hill Professional, 1994.
- 2. Power System Operation and Control by DR. K. UMA RAO, Wiley India, 2010.
- 3. Power System Operation and Control by N.V.Ramana Pearson Education India, 2010.

Course Objectives :

- 1. This course provides the knowledge of Power System Operation.
- 2. It gives the knowledge of various controls in power systems.

Course Learning Outcomes:

CO	After the completion of the course the student will be able to	Bloom	's Cognitive
		level	Descriptor
CO1	Explain the concepts of operation of power system considering various	2	Understanding
	constraints of power apparatus.		
CO2	Analyze different control methods used in power systems.	4	Analyzing
CO3	Summarize recent trends inPower System Operation.	2	Understanding

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2												
CO2	1	2												
CO3					1								2	

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2] MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

Module 1: Introduction to Characteristics of Modern Power Systems	Hrs
Physical Structure, Operation and Control Functions and Hierarchies, Design and Operating	4
Criteria	
Module 2: Equipment and Stability Constraints	Hrs
Capabilities and Constraints of Generators/Exciters/Turbines/Network Elements (Lines,	
Transformers etc.), Constraints of Energy Supply Systems, Load Characteristics, Introduction	12
to Angle/Voltage Instability phenomena, Stability Constraints.	
Module 3: Frequency Control	Hrs
Primary Control of Frequency : Governors, Secondary Control of Frequency : AGC	8
Module 4: Voltage control	Hrs
Automatic Voltage Regulators (generators), Shunt Compensation, SVC	8
Module 5: Introduction to Power Flow Control	Hrs
HVDC, FACTS, Load Curves, Unit Commitment, Introduction to the use of Optimization	
Methods	0
Module 6: Recent Trends in Power System Operation and Control	Hrs
	4

- 1. Explain the evolution and structure of power system and synchronization of power grids.
- 2. Identify the constraints of power system equipments.
- 3. Analyze the importance of maintaining the frequency constant.
- 4. Identify and explain various means of voltage control in power system.
- 5. Explain how real and reactive power scheduling is done in power systems.
- 6. Explain the role of load dispatch center.

Engineering 3 0 0 3 Course Code: 2EL414 3 0 0 3 Pre-Requisite Courses: DC Machines and Transformers, Power Electronics, Control Systems Engineering, Analog and Digital Circuits. Textbooks: 1. Massimo Banzi, "Getting Started with Arduino,", Shroff 'publications,3 rd edition 2. https://www.arduino.cc/en/Tutorial/ Arduino Examples 3. M.H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 3 rd Edition 2. Norman Nisc, 'Control System Engineering, John Wiley, Sixth Edition, 2011. 3. G.K. Dubcy, "Fundamentals of Electrical Drives", Narosa publication, 2 ^{m/2} edition Course Objectives : 1. To introduce thus to understand the analysis of physical systems using microcontrollers. 3. To enable the students to understand the analysis of physical systems. 2. To enable students to understand the analysis of physical systems using microcontroller platform. 4. To introduce thus of Arduino for control of different electrical systems. Course Learning Outcomes: CO1 Explain the features and selection criteria of microcontroller for 2 Understanding electrical systems. CO2 Implement basic microcontroller based electrical systems. 5 Evaluating <tr< th=""><th>Title of the Course: Microcontroller Applications in Electrical</th><th>L</th><th>Т</th><th>Р</th><th>Cr</th></tr<>	Title of the Course: Microcontroller Applications in Electrical	L	Т	Р	Cr						
Course Code: 3EL141 13 0 0 3 Pre-Requisite Courses: DC Machines and Transformers, Power Electronics, Control Systems Engineering, Analog and Digital Circuits. 15 0 0 15 Textbooks: 1 Massimo Banzi, "Getting Started with Arduino,", Shroff publications, 3 nd edition 2 1. Massimo Banzi, "Getting Started with Arduino,", Shroff publications, 3 nd edition 2 1 4 2. https://www.arduino.cc/en/Tutorial/ Arduino", Apress, 1 nd edition 2 1 3 6 1 1 3 6 1 1 3 6 1 1 3 6 1 1 1 3 6 1 1 1 1 3 6 1	Engineering	2	0	0	2						
Courses: DC Machines and Transformers, Power Electronics, Control Systems Engineering, Analog and Digital Circuits. Textbooks: 1. Massimo Banzi, "Getting Started with Arduino,", Shroff publications,3 rd edition 2. https://www.arduino.cc/en/Tutorial/ Arduino Examples 3. M.H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 3 rd Edition References: 1. Michael McRoberts, "Beginning Arduino", Apress, 1 ^a edition 2. Norman Nise, 'Control System Engineering', John Wiley, Sixth Edition, 2011. 3. G. K. Dubey, "Fundamentals of Electrical Drives", Narosa publication, 2 nd edition Course Objectives : 1. To introduce students to understand the analysis of physical systems using microcontrollers. 3. To enable the students to understand use of sensors and signal conditioning on microcontroller platform. 4. To introduce the use of Arduino for control of different electrical systems. Course Learning Outcomes: CO1 Explain the features and selection criteria of microcontroller for 2 Understanding electrical systems. CO2 Implement basic microcontroller based applications for electrical 3 Applying engineering. CO2 Implement basic microcontroller based electrical systems. Co3 Evaluate the performance of microcontroller based electrical systems. Co1 2 2	Course Code: 3EL414	3	0		3						
Preprieting, Analog and Digital Circuits.	Pre-Requisite Courses: DC Machines and Transformers, Power Ele	ctronics	, Cor	ntrol S	ystems						
Ivertionods: 1. Massimo Banzi, "Getting Started with Arduino,", Shroff publications,3 rd edition 2. https://www.arduino.cc/en/Turorial/ Arduino Examples 3. M.H. Rashid "Power Electronics, Circuits, Devices and Applications", Pearson Education Inc., 3 rd Edition References: 1. Michael McRoberts, "Beginning Arduino", Apress, 1 st edition 2. 2. Norman Nise, 'Control System Engineering', John Wiley, Sixth Edition, 2011. 3. G. K. Dubcy, "Fundamentals of <i>Electrical Drives</i> ", Narosa publication, 2 nd edition Course Objectives : 1. To introduce students to understand the analysis of physical systems using microcontrollers. 3. To enable the students to understand use of sensors and signal conditioning on microcontroller platform. 4. To introduce the use of Arduino for control of different electrical systems. Course Learning Outcomes: CO2 Matter the completion of the course the student will be able to iequineering. Evaluate the performance of microcontroller based applications for electrical 3 OP PO2 PO3 PO4 PO5 PO5 PO5 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02 CO1 2 2 Matter Systems of Sugment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment is 0.5% origination (ISE). One Mid Semester Examination (MSE) and one End Semester Examination (PSE) having 20%, 30% and 50% weightage respectivel	Engineering, Analog and Digital Circuits.	Engineering, Analog and Digital Circuits.									
1. brassino banzy, Octumize Variation Variations, Structure Variations, Structure Variations, Control System Engineering, John Wiley, Sixth Edition References: 1. Michael McRoberts, "Beginning Arduino", Apress, 1 ^a edition 2. Norman Nise, 'Control System Engineering', John Wiley, Sixth Edition, 2011. 3. G. K. Dubey, "Fundamentals of <i>Electrical Drives</i> ", Narosa publication, 2 ^{md} edition Course Objectives : 1. To introduce students to understand the analysis of physical systems using microcontrollers. 3. To enable the students to understand the analysis of physical systems using microcontrollers. 3. To enable the students to understand use of sensors and signal conditioning on microcontrollers. 4. To introduce the use of Arduino for control of different electrical systems. Course Learning Outcomes: Col After the completion of the course the student will be able to Bloom's Cognitive level Descriptor CO1 Explain the features and selection criteria of microcontroller for 2 Understanding electrical systems. CO2 Implement basic microcontroller based applications for electrical 3 Applying engineering. CO3 Evaluate the performance of microcontroller based electrical systems. Coi PO PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 PS01 PS02 CO1 PO PO1 PO1 PO12 PS01 PS02 CO1 PO PO1 PO1 PO12 PS01 PS02 PS02 PS02 PS02 PS02 PS02 PS02 PS02	Textbooks:	¹ adition									
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Assemblers, Compliers, Linkers, Simulators, Emulators, Debugger Programmers, Introduction	Assemblers, Compilers, Linkers, Simulators, Emulators, Debugger Programm	ners, In	troduc	tion	6						

to Arduino, Headers and Preprocessor Directives, Basic Programming in C.	
Module 2: Sensors and Signal Conditioning	Hrs.
Hall Effect Sensors for current and voltage measurement, Speed sensors, measurement of active	
and reactive power, flow and pressure measurement, temperature transducers, interfacing of	5
sensors to Arduino.	
Module 3:Embedded Control for DC machines	Hrs.
Speed control of dc motor using arduino, speed control using single phase controlled converter,	6
three phase controlled converter, dc to dc chopper, and code for switching sequences.	U
Module 4: Embedded Control for dc to dc converters	Hrs.
Types of DC to DC converters- buck, boost, buck-boost, choice of components, implementation	7
using Simulink, frequency control/ on time control for dc to dc converters.	/
Module 5:Inverter Control	Hrs.
3 phase PWM inverter design, choice of components, implementation of 120 degree and 180	
degree mode of conduction methods, Selection of sampling period and Switching frequency,	6
PWM control techniques.	
Module 6:Control Systems Design	Hrs.
Controller Specifications, design of controller using arduino, P, PI and PID controller design,	
closed loop control of physical systems, temperature control systems, and use of DAQ in closed	6
loop systems.	
Module wise Measurable Students Learning Outcomes :	
After completion of the course students will be able to:	
1. Explain features of microcontroller and various development tools.	
2. Demonstrate use of different sensors and signal conditioning using microcontrollers	
3. Implement speed control techniques for dc motor using Arduino.	
4. Understand and evaluate use of microcontrollers for dc to dc converters.	
5. Implement basic power electronics circuits using microcontroller.	

6. Use Arduino for implementing basic controllers viz. P,PI and PID

Title of	the Co	urse:	Neura	l Netw	ork ar	nd Fuz	zy Co	ntrol			L	, ,	Т	Р	Cr
Course	Code: 3	3EL41	5								3		0	0	3
Pre-Rec	quisite	Course	es: Nil												•
Textboo	oks:														
1. R	ajaskara	anPai '	Neura	l netwo	orks, Fi	uzzy Lo	ogic an	id Gen	etic Alg	gorithms	s, ' <i>PHI</i>	public	cations	s, 20	03.
2. T	imothy	J. ross	, 'Fuzz	y Logi	c with .	Engine	eering.	Applic	ations'	, Pearso	n Publi	cation	ls, 201	0	
1. Driankov, ' <i>Fuzzy Control</i> '. Narosa Publications, 2000.															
1. D 2. D	eepa. S	ivanda	y Com nan. 'I	ntrodu	ction to	o Neur	al Net	works'	. TMH	publica	tions. 2	2008.			
3. M.Gopal, 'Modern Control System -State variable analysis and Neuro fuzzy control',										TMH					
Publications, 2010.															
Course Objectives :															
1. Imparting Basic knowledge of neural network and fuzzy control.															
3. It	is inten	ided to	learn o	control	ler des	ignusi	ng neu	ral and	fuzzy	system.					
Course	Learni	ng Ou	tcomes	5:		0	0		<u> </u>	5					
COAfter the completion of the course the student will be able toBloom's Cognitive										ive					
level Descripto											iptor				
CO1Explain modern algorithm in neural network and fuzzy control.2Understar											stan	ding			
CO2Apply neuro fuzzy and genetic algorithm for various applications3Applying											ving				
CO3 Analyze hybrid controllers using combination of intelligent 4 Analyzing											zing				
theories.															
CO-PO Mapping :															
<u>CO1</u>	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	POII	PO12	2 PSC		2802
		2	2												
CO3			2												
Assessn	ient:								l						
Two con	mponen	ts of I	n Sem	ester E	Evaluat	ion (IS	SE), O	ne Mic	l Seme	ester Exa	aminati	on (M	ISE) a	nd o	ne End
Semeste	r Exam	ination	(ESE)) havin	g 20%	, 30%	and 50	% wei	ghtage	respecti	vely.				
		А	ssessn	nent							Marks	5			
			ISE 1	[10				
			MSE	2							30				
			ISE 2	2							10				
			ESE								50				
ISE 1	and IS	E 2 a	re bas	ed on	assigi	nment,	oral,	semin	ar, tes	t (surpr	ise/dec	lared/c	quiz),	and	group
discuss	ion.[Or	ne asse	ssment	tool p	er ISE.	The a	ssessm	ent too	ol used	for ISE	1 shall	not be	e used	for I	SE 2]
MSE: A	Assessn	nent is	based	on 50%	00 of CO	urse co	ontent	(Norm	ally fir	st three	module	es)	onton	+ (no	
LOE: A	Assessii	ules) c	overed	offer N	/% COU ASE	rse co	ment v	/111/0-	80% W	eigniag	e for co	Jurse C	conten	t (no	rmany
Course	Conten		overeu		10L.										
Module 1: Introduction to Neural Network												Hrs.			
Introduction, Need for Neural networks. AI and other intelligent systems. Biological neuron											on				
model.	Artific	ial mo	del for	Neuro	n, Neu	ronal c	lynami	ics, apr	olicatio	ons.	,	- 8		-	6
Module 2: Architectures and Learning											Hrs.				
Neural	networ	rk arch	itectur	es, lea	rning,	trainin	g and	testing	, perce	ptron le	arning	rule, 7	Traini	ng	
single layer network, convergence, supervised Hebb learning, performance surfaces and										nd	6				
optimu	ım poin	ts.													
Modu	le 3: M	ultilay	er neu	ral net	twork										Hrs.

_		
	Performance optimization, steepest descent, Adeline network, mean square error, LMS	
	algorithm, MLPs , back propagation, choice of network architecture, convergence, drawbacks	6
	& modification of BPN, Applications of BPN	
	Module 4: Unsupervised Networks	Hrs.
	Associative learning- simple associative learning, unsupervised Hebb's rule, simple recognition	4
	network, Instars, outstar rule, competitive learning, applications.	4
	Module 5: Fuzzy Logic	Hrs.
	Introduction to fuzzy logic, need for fuzzy logic, crisp theory and fuzzy theory, Fuzzy	
	mathematics, fuzzy mapping, fuzzy relations, fuzzy propagation, Implication rules, mamdani &	8
	sugeno models.	
	Module 6: Fuzzy Control	Hrs.
	Fuzzy rule Base structure, FKBS systems, PID control, FKBC design, FKBC PID control design	6
	and applications, Neural-fuzzy combinations, Hybrid intelligent control, applications.	U
]	Module wise Measurable Students Learning Outcomes:	
	After completion of the course students will be able to:	
	1. Explainalgorithms in neural network.	
	2. Design neural network based applications.	
	3. Explain algorithms in unsupervised neural network.	
	4. Explain algorithms in fuzzy logic.	
	 Design of controllers using fuzzy logic. Design of hybrid controllers using combination of intelligent theories. 	
-	Outcomes as regards to improvement in Communication Skills: NIL	
	Computer Lisage / Lab Tool: MATLAR	
_		
_	Laboratory Experiences: Simulations	
	Independent Learning Experiences: Case studies	

Title of the Course: PLC and SCADA L T P												(Cr			
Course	Code: 3	3EL41	6									3	0	0		3
Pre-Req	uisite	Course	es: Eleo	ctrical	Measu	remen	t, Instr	umenta	tion							
Textboo	ks:															
1. Jo	hn W.	Webb,	Ronal	d A. "I	Program	nmable	e Logi	c Cont	collers,	Princip	oles &	Appl	icatio	ons " P	ΗI	
pu	blicatio	on, Eas	tern E	conom	ic Edit	ion										
2. W	H. Bo	lton "P	rogran	nmable	e Logic	Contr	ollers"	', Newi	ness Pu	ublicatio	on.					
Referen	ces:			1.5		((D1 (. 11	P			.1 1				
I. JO	hn R.	Hackw	vorth a	and Pe	eterson	, "PLC	Con	trollers	Prog	rammin	g Me	thods	and	Appl	icatio	ns″,
2 G	arv dun	ning "	Introd	uction	to PL(gage I	earnin	σ							
Course	Objecti	ives :	muou	action			<u>5450 I</u>	Zeurmin	5.							
1. To	1. To provide basics knowledge of PLC and SCADA.															
2. To	2. To impart programming knowledge for PLC and SCADA based systems.															
3. To	3. To develop skills for use of PLC and SCADA systems in automation.															
Course	Learni	ng Out	tcomes	5:								51		~		
CO After the completion of the course the student will be able to Bloom's Cognitive																
GOL	<u> </u>					·						leve		Desci	riptor	
COI	CO1 Explain basics components used in PLC and SCADA based systems. 2 Understanding											g				
CO2 Apply ladder logic programming technique for various PLC 3 Applying																
applications.																
CO3 Use different PLC functions like timers, counters, etc. for different 3 Applying																
applications.																
	CO4Evaluate the performance of PLC and SCADA based systems.5Evaluating															
СО-РО		ng:	DO3	DO4	DO 5	DO4	DO7	DOP	DOO	DO10	DO11		12	DCO1	DEO	5
COL	POI	PO2	2	PU4	P05	PU0	P07	PUð	P09	POIU	PUL)12	P501	P502	5
	2		2													-
C03		2	-													_
CO4		_		3	2											-
Assessm	ent:															
Two con	nponen	ts of I	n Sem	ester E	Evaluat	ion (IS	SE), O	ne Mio	l Seme	ester Ex	amina	ation	(MSI	E) and	one l	End
Semester	r Exam	ination	(ESE)) havin	g 20%	, 30% ;	and 50	% wei	ghtage	respect	ively.			,		
		А	ssessm	nent	0					1	Mar	ks				
			ISE 1	-							10					
			MSE	1							30					
			ISE 2	2							10)				
			ESE								50)				
ISE 1	and IS	E 2 a	re bas	ed on	assig	nment,	oral,	semin	ar, tes	t (surp	rise/de	eclare	d/qui	z), an	d gro	up
discussi	ion.[On	ne asses	ssment	tool p	er ISE.	The a	ssessm	ent too	ol used	for ISE	E 1 sha	ıll not	be u	sed for	ISE 2	2]
MSE: A	Assessm	nent is	based	on 50%	6 of co	urse co	ontent	(Norm	ally fir	st three	modu	les)				
ESE: A	Assessn	nent is	based	on 100)% cou	rse coi	ntent w	vith70-	80% w	veightag	ge for	cours	e con	tent (r	orma	lly
last thre	last three modules) covered after MSE.															
Course	Conten	its:														
Modul	e 1: In	troduc	tion to) PLC											Hr	s.
Introdu	iction,	advan	tages,	disac	lvantag	ges, Ii	nput	module	e, Out	tput $\overline{\mathbf{N}}$	Iodule	e, me	emory	y and	6	
interfac	cing, Po	ower Su	upplies	s for Pl	LC, Ar	chitect	ure of	PLC, I	ntrodu	ction to	input	-outp	ut de	vices.		
Modul	e2: PL	C prog	gramn	ning											Hr	s.
Introdu	ction t	o Lado	ler log	ic pro	gramm	ing, o	n – of	f swite	hing c	levices,	input	t anal	og de	evices,	6	

programming on/ off inputs to produce on/off outputs, relation of digital gate logic to contact /	
coil logic, creating ladder diagrams from process control description.	
Module3: PLC Timers and Counters	Hrs.
PLC timer functions, Types of timers, Programming for On delay timers, off delay timers and	6
Pulse timers, Retentive Timers, PLC counter functions, Up/down counters and their	
programming, PLC applications with timers and counters.	
Module 4: PLC Intermediate and Data Handling Functions	Hrs.
PLC Arithmetic functions, PLC trigonometric and log functions, PLC basic comparison	6
functions, PLC advanced comparison functions, Master control relay functions, Programming	
PLC for fail safe operation using Master Control Relay, PLC Jump functions, Jump with return	
and non-return, PLC data move system, Moving large blocks of PLC data, data handling	
functions.	
Module5: PLC Bit Functions and PLC Networking	Hrs.
Digital bit functions and applications, Bit patterns in register, Shift Register Functions and	6
applications, Analog PLC operations,	
Networking of PLCs-Levels of Industrial Control, Types of Networking, Network	
Communications.	
Module 6: Introduction to SCADA	Hrs.
Components of SCADA, SCADA functions, co-ordination and control, advantages, Power	6
System Automation using SCADA.	
Module wise Measurable Students Learning Outcomes	
After completion of the course students will be able to:	
1. Describe the basics of PLC systems.	
2. Develop basic programs in PLC by using ladder diagrams.	
3. Describe various timer and counter functions in PLC.	
4. Applyintermediate and data nanding functions for different applications.	
6. Outline the basics of SCADA components and functions.	
Outcomes as regards to improvement in Communication Skills:	
Computer Usage / Lab Tool: PLC trainer kit, RSMicrologix, RSLinx, RSEmulate 500	
Laboratory Experiences: 2 Hrs./week	
Independent Learning Experiences: Students will work in groups to design practical system	
independent Learning Experiences. Students will work in groups to design practical system.	

Professional Elective (Lab) Courses

T	itle of	the Co	ourse: A	Advan	ced Po	wer E	lectro	nics L	ab			Ι		Γ	2	Cr
C	ourse	Code:	3EL45	2								() () (2	1
P	re-Re	quisite	Course	es: Pov	ver Ele	ctroni	cs									
Т	extbo	oks:														
	1. N	И. Н.R	ashid,	Power	Elect	ronics.	circu	its de	vices	and ap	oplicatio	ons, Pe	earson	Educat	ion,	Third
	e	dition														
R	eferei	ices:														
	1. B. K. Bose, Modern Power Electronics & AC drives, PHIPL, New Delhi															
	2. M. B. Patil, V. Ramayanan and V. T. Ranganathan, Simulation of Power Electronics circuits,															
	N	Varosap	ublicati	on.												
C	ourse	Objec	tives :					~ ~ ~								
	1. To provide the advance knowledge in the field of power electronics.															
	2. To understand the working of different power electronic converter through simulation and															
	с 3 Т	o deve	lon the	1. skills o	of simu	lation	analy	sis and	desig	n of po	wer elec	etronics	system	n		
С	$\frac{9.1}{000000000000000000000000000000000000$	Learn	ing Ou	tcome	5: 5:	ination,	, anary	sis and	uc512	,n or po		uomee	system	.1.		
	CO After the completion of the course the student will be able to Bloom's Cognitive															
	00	111001		npien	/II 01 01			Stude		ii be us		1	evel	Desc	rint	or
	[~] 01	Artic	ulate	worki	ng of	diffe	rent a	dvanc	red n	ower (electror	nic	2	Under	stand	ling
		conve	erters	W OI KI	15 01	unite	i ent u	u v une	ou p	0	01001101	ne	2	Onder	Juin	*****5
	CO2	Analy	ze diffe	erent ac	lvance	d pow	er elect	ronic	conve	rters an	d system	ns	4	Ana	vzir	ıσ
	CO2	Evalu	ate the	perfo	rmance	$\frac{a}{b}$ of d	lifferen	t adva	anced	nower	electro	nic	5	Fval	uatii	10 10
	.05	conve	rters us	ing har	dware	and si	mulatio	n soft	ware	power	ciccuo		5	Lvai	uatii	15
C	0-P0	Mann	ing •	ing nui	u ware	und 51	manati	5011	ware.							
	0-10		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS	502
	CO1		101	1.00	3	100	100	10.	100	107	1010	1011	1012	1.001		/01
	CO2			2												
	CO3					1										1
L	Lab Assessment:															
T	There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.															
IN	MP: Lab ESE is a separate head of passing.															
-															1	
	Asses	essessment Based on Conducted by Conduction and Marks Submiss										ission	Ma	arks		

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities,	Lab Course Feeulty	During Week 1 to Week 4	25
LAI	attendance, journal	Lab Course Faculty	Submission at the end of Week 5	23
1.4.2	Lab activities,	Lab Course Feeulty	During Week 5 to Week 8	25
LAZ	attendance, journal	Lab Course Faculty	Submission at the end of Week 9	23
LA2	Lab activities,	Lab Course Feeulty	During Week 10 to Week 14	25
LAS	attendance, journal	Lab Course Faculty	Submission at the end of Week 14	23
Lob ESE	Lab Performance and	Lab Course faculty	During Week 15 to Week 18	25
LaU ESE	related documentation	Lab Course faculty	Submission at the end of Week 18	23

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

- 1. Development of Simulink model and analysis of performance of Single Phase Full and Half controlled converter.
- 2. Development of Simulink model and analysis of performance of Three Phase Full and Half controlled converter
- 3. Development of Simulink model and analysis of performance of Cascade type Multilevel Inverter.

- 4. Development of Simulink model and analysis of performance of Diode clamped Multilevel Inverter.
- 5. Experimental study of cascade type Multilevel inverter
- 6. Development and performance analysis of Active power Filter
- 7. Development of Simulink model and analysis of performance of Z source inverter
- 8. Study and performance analysis of Matrix converter.

Computer Usage / Lab Tool: Simulation Lab and Power Electronics Lab

Title o	of the Co		Ι		Т	P	Cr								
Cours	e Code:	3EL45	3								()	0	2	1
Pre-R	equisite	Course	es: Coi	ntrol S	ystem	s Engi	neerin	g Lab				•			
Textb	ooks:														
1.	George S Prentice-	Stephar Hall of	nopoul f India	os, "C 1 st Ed	hemication 1	al Proo 984	cess C	ontrol	- An	introdu	ction to	o Theo	ory a	and I	Practice",
Refer	ences:	11411 01	i inaia,	1 124		<u>, , , , , , , , , , , , , , , , , , , </u>									
1.	1. Thomas E. Marlin, "Process Control - Design Processes and Control System for Dynamic														
	Performance, 2 nd Edition", Mc Graw Hill publication.														
2.	2. F.G. Shinskey, "Process Control System – Application, Design and Tuning", McGraw-Hill														
2	Publication, 3 rd Edition, 1988.														
3.	3. Curtis D. Johnson, "Process Control Instrumentation Technology", 7 th Edition, Pearson Education, 7 th Edition, 2002														
Cours	7 th Edition. 2003.														
1	1 This course intends to provide mathematical model of the process and verification with														
	experimentation.														
2.	2. It demonstrate the various types of controllers for SISO system.														
3.	It provi	de sim	ulatior	n of va	arious	advanc	ced co	ntrolle	rs used	d in pro	cess c	ontrol	and	mult	ivariable
	predictiv	ve cont	rol.												
Cours	e Learni	ng Ou	tcomes	s:											
CO	After t	the con	npletio	on of tl	ne cou	rse the	e stude	nt will	l be ab	le to		Bloo	m's	Cogn	itive
												level		Des	criptor
CO1	Experi	iment	on v	various	Proc	ess C	Control	syste	ems to	o evalu	late	3		App	lying
	perform	nance.													
CO2	Apply	the tur	ning teo	chnique	es for t	he con	troller	S.				3		App	lying
CO3	Evalua	ate the	perform	mance	of give	en Proc	cess Co	ontrol s	system	•		5		Eval	uating
CO4	Demor	nstrate	the us	e of ad	lvance	contro	ller.					3		App	lying
CO-P	O Mappi	ing:													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	P	SO1	PSO2
CO	1			2											
CO	2			2											
CO	3			3											
CO	4			3	2										
Lab A	ssessmei	nt:													
There	There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.														

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks		
I A 1	Lab activities,	Lab Course Faculty	During Week 1 to Week 4	25		
LAI	attendance, journal	Lab Course Faculty	Submission at the end of Week 5	23		
I A 2	Lab activities,	Lab Course Feeulty	During Week 5 to Week 8	25		
LAZ	attendance, journal	Lab Course Faculty	Submission at the end of Week 9	23		
1.43	Lab activities,	Lab Course Feeulty	During Week 10 to Week 14	25		
LAJ	attendance, journal	Lab Course Faculty	Submission at the end of Week 14	23		
Lob ESE	Lab Performance and	Lab Course feculty	During Week 15 to Week 18	25		
LaU ESE	related documentation	Lab Course faculty	Submission at the end of Week 18	23		

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

List of Experiment

- 1. Step response of first order system (single capacity system).
- 2. Step response of multi capacity process (coupled tank system).
- 3. Study of a computer controlled pressure control system.
- 4. Tuning of P PI and PID controllers based on process reaction curve and Ziegler Nichols method.
- 5. Study of computer controlled level control system.
- 6. Study of computer controlled flow control system.
- 7. Tuning of controllers for level control system.
- 8. Tuning of controllers for flow control system.
- 9. Study of cascade controller for a flow control system.
- 10. Study of PLC and its process controlled applications.

Computer Usage / Lab Tool:

Matlab simulation experiments.

Title of the Course: Power System Operation and Control Lab	L	Т	Р	Cr
Course Code: 3EL 454	0	0	2	1

Pre-Requisite Courses:

1. Power System Engineering, Power System Analysis and Stability, Control System Engineering, Power Electronics.

Textbook:

1. Power System Analysis: by Hadi Saadat, McGraw-Hill, International edition, 1999.

References:

- 1. Power System Analysis & Design by Glover, Sarma & Overbye, Thomson, IV edition, 2007
- 2. User manuals MiPower Power System Analysis software, PRDC, Bengaluru.

Course Objectives :

- 1. This course provides the knowledge of Power System Operation.
- 2. It gives the knowledge of various control techniques used in Power Systems.

Course Learning Outcomes:

CO	After the completion of the course the student will be able to	Bloom's Cognitiv		
		level	Descriptor	
CO1	Illustrate the use of different techniques for power system operation, in	3	Applying	
	simulated environment.			
CO2	Analyze the performance of power system under various operating	4	Analyzing	
	constraints, through simulation.			
CO3	Evaluate different power flow control methods through simulation.	5	Evaluating	

CO-PO Mapping :

-	11	0									-			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1				3										
CO2				3	2									
CO3		3				2								

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

Using MATLAB / Power world Simulator / MiPower softwares,

- 1. Computation of Complex Power flow and verification of effect of load angle on active power flow.
- 2. Computation of power delivered by a generator connected to infinite bus.
- 3. Computation of maximum power capacity of lossless line and loadability limits.
- 4. Load flow study of IEEE-30 bus system using Gauss-Seidel, Newton-Raphson and fast decoupled methods.

- 5. Computation of Optimal dispatch of power for generator units in a plant. Computation of Optimal dispatch of power for generator units in a plant.
- 6. Computation of Optimal dispatch of power for generator units in a plant by considering losses & generator limits.
- 7. Short circuit study of generator under faults.
- 8. Computation of steady state stability under small disturbances.
- 9. Transient stability study for single machine and multi-machine systems.

Computer Usage / Lab Tool: MATLAB, Power world Simulator, etc.

PO-b: Design and conduct experiments, analyze and interpret data.

PO-e: Identify, formulate and solve issues in electrical engineering.

PO-h: Understand the impact of engineering solutions.

PO-k: Use the techniques, skills and modern engineering tools necessary for Electrical Engineering.

	0 (1	0							•					1	
Title	of the	Cou	rse: N	Aicroc	ontrol	ller A	Applica	ations	in .	Electric	al L	, T	`]	P	Cr
Engine	ering L		-								0	0		,	1
Course	e Code: .	3EL45	5				1	0	-					2	1
Pre-Re	quisite	Cour	ses: 1	DC M	lachine	es and	1 Tra	nsform	ers,	Power	Electro	nics, (Control	Sy	stems
Engine	Engineering, Analog and Digital Circuits Textbooks:														
Textbo	Textbooks:														
1. 1	Massimo	Banzi	, "Gett	ing Sta	arted w	rith Are	duino,'	', Shro	ff put	olication	s,3 ^{ra} edi	ition			
2. ł	nttps://w	ww.arc	luino.c	c/en/T	utorial	/ Ardu	iino Ex	kample	s					Ŧ	a rd
3. 1	M.H. Ra	shid "I	Power	Electro	onics,	Circuit	s, Dev	ices an	nd Ap	plication	ns", Pea	rson E	ducatio	n In	ic., 3^{ru}
Defense	Edition														
Kelere	$\mathbf{nces:}$	N (D 1		.		1 • • •		1 st	1						
	Viichael	MCKOt	Derts, "I	Beginn	ing Ar	duino	, Apre	$SS, 1^{\infty}$	edition	l Al Edit	ian 201	1			
2.1	Norman \mathbb{C} K Du	INISE,	Contro	1 Syste	of Flo	gineerii atriaal	ng, Jo	nn wu s'' No	roso n	un Eulu ublicatio	201 201 2^{nd}	1. dition			
Course	D. K. Du	ives •	unuan	lentais	<i>oj Lie</i>	tintui	Drives	s , 11a	iosa p	uncan	<i>m</i> , <i>2</i> C	union			
	Introduce	studo	nto tha	use of	micro	control	llors fo	r alact	rical a	ustams					
	Introduce Enable th	e stude	ents to	use of	stand th	ne anal	licis in	f nhvsi	cal svs	tems us	ing mic	rocontr	ollers		
3	Enable st	udents	to und	lerstan	d use c	of sense	ors and	l signa	l cond ⁱ	tioning	on mici	ocontro	oller nl	atfor	m
4. 1	Introduce	e the us	se of A	rduino	for co	ntrol o	f diffe	rent ele	ectrica	l system	IS.		, 1101 pr		
Course	e Learni	ng Ou	tcomes	5:											
CO	After	the cor	npletio	on of t	he cou	rse th	e stud	ent wil	l be a	ble to		Bloo	m's C	ognit	tive
			•									level	De	escri	ptor
C01	Imple	ment c	ontrol	circuit	s for e	lectrics	al syste	ems usi	no mi	crocontr	oller	3	A	nnlv	ing
$\frac{cor}{cor}$	Liso m	icrocor	ntroller	for co	ntrol e	vetem	annlice	ations	ing ini		01101	3		pp1y	ing
	Evolution Evolution	ate the			onuors	vstem	appile	auons	d ala	tricol a	votomo	5			ting
005	Evalua					IICIOCC	muone	er base	u elec	uncar s	ystems	5	EV	aiua	ung
GODO		siniurai	lon stu	lay											
CO-PC) Mappi	ng:				-			-		2011	2010	-		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS	<u>502</u>
CO1				3										_	
CO2			2												
CO3		2			1										
Lab As	ssessmer	nt:													
There a	re four c	compoi	nents o	f lab as	ssessm	ent. L	A1, LA	A2, LA	3 and	Lab ESI	E.				
IMP: L	ab ESE i	is a sep	oarate l	nead of	passir	ıg.	,	,							

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
I A 1	Lab activities,	Lab Course Faculty	During Week 1 to Week 4	25
LAI	attendance, journal	Lab Course I acuity	Submission at the end of Week 5	23
1 4 2	Lab activities,	Lab Course Faculty	During Week 5 to Week 8	25
LAZ	attendance, journal	Lab Course Faculty	Submission at the end of Week 9	23
1.4.2	Lab activities,	Lab Course Feeulty	During Week 10 to Week 14	25
LAS	attendance, journal	Lab Course Faculty	Submission at the end of Week 14	23
Lob ESE	Lab Performance and	Lah Course feaulty	During Week 15 to Week 18	25
Lab ESE	related documentation	Lab Course faculty	Submission at the end of Week 18	23

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

- 1. Interfacing Hall Effect current sensors to Arduino.
- 2. Interfacing Hall Effect voltage sensors to Arduino.

- 3. Measurement of power using Arduino.
- 4. Speed control of DC motor using Arduino (single phase controlled converter method)
- 5. Speed control of DC motor using Arduino (DC to DC chopper method)
- 6. Buck converter using Arduino.
- 7. Boost converter using Arduino.
- 8. Pulse generation for PWM inverter using 120 degree mode of conduction.
- 9. Pulse generation for PWM inverter using 180 degree mode of conduction.
- 10. Study of P, PI, PID controllers using Arduino

Computer Usage / Lab Tool:

Use of software simulation tools like MATLAB/Simulink, LABVIEW, Arduino compiler

Title of the Course: Neural Network and Fuzzy Control labLTP										(Cr						
C	ourse (Code:	3EL45	6									0	0	2		1
P	re-Req	uisite	Course	es: Nil													
Т	extboo	ks:															
	1. Ra	ijaskar	an, Pai	' Neur	al netv	vorks,	Fuzzy I	Logic d	and G	enetic A	lgorithn	ns, ' Pl	HI pu	blica	tions,	2003.	
	2. Ti	mothy	J. ross	, 'Fuzz	y Logi	c with	Engine	eering	Appli	cations'	, Pearso	n Pub	licatio	ons, 2	2010		
R	eferen	ces:															
	1. Di	rianko	v, <i>'Fuzz</i>	sy Con	<i>trol'</i> ,N	larosa	Publica	ations,	2000								
	2. De	eepa, S	Sivanda	nan, ' <i>I</i>	ntrodu	ction	to Neur	al Net	works	', TMH	publica	tions,	2008	•			
	3. M	.Gopa	l,' <i>Mode</i>	ern Co	ontrol	System	m -Sta	te var	riable	analys	is and	Neur	o fuz	zy c	contro	l', TN	MН
	Pu	iblicati	ions, 20)10.													
C	Course Objectives :																
	1. Imparting Basic knowledge of neural network and fuzzy control.																
	2. To develop skills of design of neuro fuzzy and genetic algorithm.																
	3. It is intended to learn controller design using neural and fuzzy system.																
C	Course Learning Outcomes:																
COAfter the completion of the course the student will be able toBloom's Cognitive																	
	level Descriptor																
-	CO1	1Demonstrate the Neural Networks and Fuzzy Control techniques.3Applying											ing				
-	CO2	Analy	y ze diff	erent N	Veural	Netwo	orks and	d Fuzz	y Cor	ıtrol			4	A	Analyz	zing	
	CO3	Evalu	ate dif	ferent	Neural	Netw	orks ar	nd Fuzz	zy Co	ntrol			5	I	Evalua	ting	
C	O-PO	Марр	ing :											•			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12 I	PSO1	PSO2	
	CO1				3												
	CO2				2												
	CO3				2	1											
L	ab Ass	essme	nt:														
Т	here are	e four	compor	ients o	f lab a	ssessn	nent, L	A1, LA	2, LA	A3 and I	Lab ESE	E.					
Π	MP: Lal	o ESE	is a sep	oarate l	nead of	f passi	ng.										
	Assess	ment		Based	on		Cond	lucted b	у	Condu	action an	d Marl	ks Sub	missi	on	Marks	5
	LA	1	La	ab activ	vities,		Lab Coi	urse Fa	culty	During	Week 1	to Wee	ek 4			25	
			atter	<u>idance,</u>	journa	1				Submis	sion at th	he end	$\frac{\text{ot We}}{1}$	ek 5		_	_
LA2 Lab activities, attendance journal Lab Course Faculty Submission							week 5	to wee	ek 8 of We	ak 0		25					
			La	ab activ	journa vities	1				During	Week 10	$\frac{100}{10}$ to W	$\frac{01}{2}$ we				_
	LA3 attendance, journal					1	Lab Course Faculty During Weel Submission			sion at th	on at the end of Week 14				25		
	Lab ESE Lab Performance and				nd	Lak Cause for 1 During Wee			Week 1	15 to Week 18				25			
		DE .	relate	d docur	nentati	on			uny	Submis	sion at th	he end	of We	ek 18	3	23	

Week 1 indicates starting week of Semester.

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Course Contents:

- 1. To study the Neuron model and architectures using NN toolbox.
- 2. Development of the simulation for steepest descent NN algorithm.
- 3. Development of the simulation for LMS NN algorithm.
- 4. Development of the simulation for back propagation -momentum NN algorithm.
- 5. Development of the simulation for variable learning rate.
- 6. Development of FKBS systems -FKBC Proportional control.
- 7. Development of FKBS systems -FKBC PD control.

8. Development of FKBS systems -FKBC PID control. Computer Usage / Lab Tool: Use of software simulation tools like MATLAB/Simulink

Т	Title of the Course: PLC and SCADA Lab									L	Т	Р	(Cr			
C	ourse	Code:	3EL45	7			~~						0	0	2		1
P	re-Red	misite	Course	es: Ele	etrical	Measu	iremen	t Instr	umen	tation			°	Ũ			
т	Textbooks.																
I	1 John W Webb Ronald A "Programmable Logic Controllers Principles and Applications" PHI																
	1. J(JIII W.	webb,	Konar	u A. I			e Logi	c Con	uoners,	, Princip	nes an	u App	mcati	lons	ГПІ	
	p Q V		ion, Eas	stern E	conom		tion.	11 2	• • •	р	1.1						
D	2. w.m. bonon riogrammable Logic Controners, Newness Publication. References:																
К	L John D. Hookworth and Datamon "DIC Controllors Programming Mathada and Applications"																
	1. John R. Hackworth and Peterson, "PLC Controllers Programming Methods and Applications",																
		earson	Publica	ition.		to DI (On Com	~~~ T									
6	<u> </u>	ary du	nning, tirvog t	Introd	uction	10 PL		igage L	Learni	ng.							
U		Objec	lives :	as of D	I C an	4 5 C A	D٨										
	 10 provide basics of PLC and SCADA. To impart programming knowledge for PLC and SCADA based systems 																
	2. I 3 T	To develop skills for use of PLC and SCADA systems in automation															
(<u>.</u> 'nurse	3. To develop skills for use of PLC and SCADA systems in automation.															
	Ourse Learning Outcomes:																
	After the completion of the course the student will be able to Bloom's Cognitive																
-	<u>CO1</u>	Encor	40.000		4 1	d an D	ICan						2	1	Desc		
		Exect	ite expe		is base	a on P	$\frac{LC}{\cdot}$		DA Sy	stems.	•		3		App		
	CO2	Apply	y ladd	er log	gic pr	ogram	ming	techni	ique	for va	arious	PLC	3		Арр	lyıng	
		applic	ations.														
	CO3	Use d	lifferen	t PLC	functi	ons lil	ke tim	ers, co	unter	s, etc. f	for diffe	erent	3		App	lying	
		applic	ations.														
C	O-PO	Mapp	ing :														
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	12 F	PSO1	PSO2	
	CO1		2		3												
	CO2				3					2							
	CO3				3					1							
L	ab As	sessme	nt:							•				•			
Т	here a	e four	compoi	nents o	f lab a	ssessm	ent, L	A1, LA	.2, LA	A3 and I	Lab ESE	<u>.</u>					
Π	MP: La	ıb ESE	is a sep	oarate l	nead of	passir	ıg.	,	, ,								
	Asses	sment		Based	on		Cond	lucted b	by	Condu	uction an	d Marl	ks Sub	missi	on	Marks	
	LA	A1	L	ab activ	vities,	, I	Lab Cou	urse Fac	culty During Week 1 to Week 4 25								
			atter	ndance,	journa	1			Submission at the end of Week 5					_			
	LA	42	L attei	ao acuv ndance	iourna	1 I	Lab Cou	urse Fac	Faculty Submission at the end of Week 0 25								
	•		L	ab activ	vities.	· ·	1.0		1.	During	Week 1	$\frac{100000}{0}$ to We	$\frac{1}{2}$ eek 14			25	
	LA	43	atter	ndance.	journa	1 1	Lab Course Faculty Submission at the end of Week 14							25			

Week 1 indicates starting week of Semester.

Lab Performance and

related documentation

Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments.

Lab Course faculty

During Week 15 to Week 18

Submission at the end of Week 18

25

Course Contents:

Lab ESE

- 1. Study of components of Relay logic and PLC logic.
- 2. Development of Ladder Diagram for ON/OFF and latching functions.
- 3. Development of PLC programming for Motor Reversal control.
- 4. Development of PLC programming for Stair case lighting.
- 5. Development of PLC programming for Running Lighting.
- 6. Development of PLC programming for Arithmetical Functions.

- 7. Development of PLC programming for Traffic control system.
- Bevelopment of PLC programming by using Timer functions.
 Development of PLC programming for Counter function.

Computer Usage / Lab Tool

PLC Trainerkit, Control and Instrumentation Lab

Laboratory Experiences:

2 Hrs/week

Open Elective Courses

Title of	e of the Course: Open Elective III: Industrial Au								tion			L	Т	Р		Cr
Course	Code: 1	1 OE 4 4	3									3	0	0		3
Pre-Req	uisite	Course	es: Nil													
Textboo	oks:															
1. Jc	ohn W.	Webb,	Ronal	d A. R	leis "P	rogran	nmable	e logic	contro	ollers, pr	rincipl	es &	appli	cation	s" by	У
	HI publ	ication	, Easte	ern Eco	nomic	Editio	n.	4 1	· · · · ·	_ ??						
2. C.	D. Jon	inson,	Proce	ss cont	rola	Instrun	nentati	on tecr	iniques	8.						
	ces:	Stanhai	anoul	or "C	homic	al Drov	DAGG C	ontrol	٨n	introdu	otion	to Th	ooru	and D	racti	ice"
1. U P1	rentice-	Hall of	Iopour India	1 st Ed	ition 1	ar 1100 984	.css c	onuoi	- All	muouu	20011	10 11	cory	anu i	lacti	,
2. " <i>I</i>	2. "Fundamentals of Electrical Drives", G. K. Dubey, Narosa publication, 2 nd edition.															
Course	Course Objectives :															
1. T	1. This course intends to develop basics of ladder logic programming for PLC.															
2. It	 It provides the foundation level knowledge of SCADA System. 															
3. It gives overview of various types of controller for closed loop control.																
4. It provides the applications of variable speed drives in industries.																
Course	Learni	ng Ou	tcomes	5:		(1				•		DI		2 0	•,•	
CO	After	the cor	npletio	on of t	he cou	rse the	e stude	ent wil	l be at	ole to			oom	's Cogi	nitive	3
0.01	~		•									leve	1	Descr	ptor	·
COI	Comp	are the	vario	is type	$\frac{s \text{ of } co}{r}$	ntrolle	$\frac{1}{2}$	Industr	1al Au	tomatio	1.	2	U	ndersta	Indir	ıg
CO2	Apply	the kn	owledg	ge of P	LC and	d SCA	DA for	r Indus	trial A	utomati	on.	3	A	pplyin	g	
CO3	Explai	in the u	ise of v	variable	e speed	d drive	s for Ir	ndustri	al Auto	omation.		2	U	ndersta	ndir	ıg
CO-PO	Mappi	ng:										1 = -				
<u>CO1</u>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011	PO	12	PSO1	PSO	2
		$\frac{2}{2}$			2							_				_
		2			~	2						_			2	_
						2									-	
	4 .															
Assessm	ient:	to of I	n Sam	actor E	Zvoluot	ion (I		no Mi	1 Same	ostor Ex	omino	tion (MGE	E) and	ono	End
Semester	nponen r Evam	ins Of T		bavin	$\sigma 20\%$	30%	and 50	106 Wei	ahtaga	respect	amma ivelv		MOL	L) and	one	LIIU
Semeste) navin	g 2070	, 3070		70 WCI	ginage	respect	Marl	76				
		Π		ient							10	10				
			MSE	,							30					
			ISE 2	, ,							10					
			ESE 2	-							50					
ISE 1	and IS	E 2 a	re bas	ed on	accim	nment	oral	semin	ar tes	t (surnr	JU ise/de	clared	1/ani	\overline{z} and	l are	oun
discuss	ion [Or		ssment	tool n	er ISE	The a	ssessm	ent to	al used	for ISF	1 sha	ll not	he ii	sed for	ISE	21
MSE: A	Assessn	nent is	based (n 50%	6 of co	urse co	ontent	(Norm	ally fir	st three	modu	les)	u u	5 cu 101	IDL	2]
ESE: A	ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally								allv							
last three modules) covered after MSE.																
Course	Conten	ts:			1021											
Modul	e 1: Me	easure	ment o	of Vari	ous Pr	ocess	Paran	neters							Н	[rs.
Measur	ement	of qua	ntities	such as	s temp	erature	, press	sure. fo	rce. di	splacem	ent. s	peed.	flow	level.	+	
humidi	midity, pH etc., signal conditioning, estimation of errors and calibration.															
Modul	Iumidity, pH etc., signal conditioning, estimation of errors and calibration. Hrs. Module 2: Process Control and Various Controllers Hrs.													H	lrs.	

Module 2: Process Control and Various ControllersHrs.Introduction to process control, PID controller and tuning, various control configurations such as
cascade control, feed forward control, split range control, ratio control, override control and
selective control.6

Module 3: Actuators	Hrs.
Introduction to various actuators such as flow control valves, Hydraulic and pneumatic, servo	6
motors, symbols and characteristics.	
Module 4: PLC	Hrs.
Introduction to sequence control and relay ladder logic, basic PLC system, I/O modules, scan	
cycle, programming of timers, counters and I/O programming.	0
Module 5: SCADA for Industrial Automaton	Hrs.
Components of SCADA systems, functions, classification of SCADA, networking and	6
communication protocols.	U
Module 6: Variable Speed Drives	Hrs.
Role of variable speed drives in automation, DC drives, AC drives and synchronous motor drives	6
applications of variable speed drives.	U
Module wise Measurable Students Learning Outcomes :	<u> </u>
After the completion of the course the student should be able to	
1. Demonstrate the use of various transducers for Industrial Automation.	
2. Select and tune the controllers for various closed loop systems.	
3. Explain the use of actuators in Industrial Automation.	
4. Apply ladder logic techniques to solve the problems in Industrial Automation.	
5. Explain the functions of SCADA systems.	
6. Select the appropriate drive for specific application.	

Minor Specialization Courses



Walchand College of Engineering, Sangli (An Autonomous Institute) Minor in Electrical Engineering Structure

Somostor		Course Nome	Cradita	Faculty and its	Available
Semester		Course Maine	Creans	Address	on
				Prof. Bhuvaneshwari	
Semester- III	Elect	rical Machines	3		Swayam
				IIT, Delhi.	
	Powe	er System Generation,	_	Prof. D.P. Kothari	
Semester- IV	Trans	smission and Distribution	3		NPTEL
				IIT, Delhi.	
				Prof. Ramkrishna	
Semester- V	Cont	rol Engineering	3	Pasumarthy	NPTEL
				III, Madras.	
Somester VI	Indus	strial Drives - Power	2	Prof. K. Gopakumar	NDTEI
Semester- vi	Elect	ronics	5	IISc Bangalore	NFILL
				Prof Santanu	
		Microprocessors and		Chattonadhyay	
			3	Chanopadhyay	NPTEL
	e I	Microcontrollers		IIT, Kharagpur.	
Semester- VII	tive	Electrical Measurement		Prof. Avishek Chatterjee	
	Ilec	and Electronic	3	5	NPTEL
	H	Instruments		IIT, Kharagpur.	
		Seminar I	1		
		Seminar 1	1		
		Industrial Automation		Prof. S. Mukhopadhyay	
		and Control	3		NPTEL
	Π			IIT, Kharagpur.	
Semester- VIII	tive			Prof. Amit Kumar Jain	
	lect	Electric Vehicle	3		NPTEL
	E			IIT, Delhi.	
		Seminar II	1		

Semester	III	IV	V	VI	VII	VIII	Total
Credits	3	3	3	3	4	4	20

Honors Specialization Courses

M Destant M		Walchand Co	ollege	of Eng	gineer Institi	ing, Sang l	i				
		Teaching and Evalua	tion S	cheme	effec	tive from 2	2020-21				
	B. Tech	in Electrical Engineering	with S	pecial	izatio	n Electric	al Vehicle Tec	hnolog	y		
	[Course]	ſeachi	ng Sc	heme	Evalua	tion So	heme		
		N	Ŧ	T	р		C	Marks		S	
Semester	Code	Name	L	I	P	Credits	Component	Max	Pa	assing	
		Core 1. Energy					ISE 1	10			
5 th		Storage Systems for	4			4	MSE	30		40	
5		FV	•				ISE 2	10		10	
							ESE	50	20		
							ISE 1	10			
6^{th}		Core 2: Introduction	4			4	MSE	30		40	
0		to Electrical Vehicles					ISE 2	10			
							ESE	50	20		
		Elective 1 Power					ISE 1	10			
		Electronics in					MSE	30			
		Electrical Vehicle /					ISE 2	10			
7 th		Case studies in EV Development,	4			4	ESE	50	20	40	
		Elective 2 EV					ISE 1	10			
		Technology and Grid					MSE	30			
		management /					ISE 2	10			
8 th		Artificial Intelligence in EV / Computer aided Vehicle design.	4			4	ESE	50	20	40	
8 th		Mini Project	2			2	ISE ESE	50 50	20	40	
		Total	18			18	Total Total Co	Total Credits: 18 Total Contact Hrs:18			

EVEN Semester

Professional Core (Theory) Courses

Professional Core (Lab) Courses

Title o	of the Course: Engineering Management,	and Ethics 3IC 401	L	Т	Р	Cr					
			4	0	0	4					
Textb	ooks:										
1. 2. 3. 4. 5.	 Management: Theory and Practice; A.I.T.B.S. Publishers, Delhi N.C. Jain, Saakhshi Principles and Practice of Management - L.M. Prasad Principles of Management; Himalaya Publishing House - T. Ramasamy Modern micro economic theory – H.L. Ahuja, S.Chand. Engineering economics – Sullivan, Wicks, Koelling – Pearsons. 										
Refer	ences:										
1. 2. 3. 4. 5. 6.	Principles of Management; P.C. Tripathi and Business Management; - J. C. Sinha, V. N. M Principles of Management - Koontz and O'Do Management: A Functional Approach - Joseph Stonier & Hague – A text book of economic th Industrial organization and engineering economic	P.N. Reddy, Tata McGrav ugata, S. Chand & Co., Ne onnell h M. Putti leory, Pearson nics – Banga and Sharma	v Hills I w Delh	Pub. Co i	ompany	Ltd.,					
Cours	e Objectives :										
1.	To provide insight into management, economic	cs and ethics.									
2.	To manage effectively business operations and	project management team	ıs.								
3.	To meet the challenges for contemporary profe increasingly complex management problems fa	essional practice; be able to aced by industry.	o adapt	and so	lve the						
Cours	e Learning Outcomes:										
00	After the completion of the course the stu	dant should be able to	E	Bloom'	s Cognit	ive					
	After the completion of the course the stu	dent should be able to	Lev	rel	Descrip	otor					
CO1	Perceive and describe key management t economics terminologies and organizational /	heories and approaches, business ethics.	2	U	ndersta	nding					
CO2	Grasp the market scenario and apply the production and Human Resource management	principles of financial,	3		Appl	У					
CO3	Examine various cost factors for different situations and make optimal economic decisio	t alternatives in project ns.	4		Analyz	ing					
CO-P	O Mapping: Common to all branches.			•							
Teach (MSE)	Teacher Assessment : Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.										
	Assessment	M	arks								
ISE 1 10											

30

10

50

MSE

ISE 2

ESE

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	
Module 1: Basics of Management	Hrs.
Management: Definition, objectives, Nature & importance of management, management approaches, principles of management, managerial roles & skills, Recent trends & challenges of management in Global scenario. Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory, X and Theory Y, Mayo's Hawthorne Experiments, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs	7
Module 2: Principles of Management	Hrs.
 Planning: Meaning, Importance, Planning process; Types of Plans - Objectives, Strategy, Policy, Procedure, Method, Plan vs. Programme, Decision making, types of decision, Decision-Making steps Forecasting methods Organizing: Definition, Nature & purpose, Principles, Process, Types and structure of organization Staffing: Nature & purpose, recruitment policies and selection procedure, Induction/orientation, carrier development, carrier stages & performance appraisal Directing and Co-ordination: Directing: Concept and importance, creativity & innovation, Elements of Directing - Supervision, Motivation (Theories), Leadership (styles & theories), Communication (Barriers to effective communication) Co-ordination: Concept and Importance, Limitations; Types- Internal and External; Co-ordination- the Essence of Management Controlling: Concept and importance, Limitations, process of controlling, Requirements of good control system, Types of control, Techniques of Control, Relationship between Planning and Controlling; Change Management 	12
Module 3: Introduction to Functional areas as Marketing Management	Hrs.
 Financial Management: Scope, Sources of finance, capital types, financial statements, balance sheets, Profit & Loss A/C Production Management: Objectives, Site selection & factors affecting site selection , plant layout (objectives, principles, merit & demerit of each type) Human Resource Management: Introduction, Importance, Functions of H.R.M, Job 	7

Title of	the Course: Project – II SPAI/ Institute	L	Т	Р	Cr							
Course	Code: 3EL492	0	0	16	8							
Pre-Re	quisite Courses:											
Textbo	oks: Suitable books based on the contents of the project selected.											
Referen	nces: Suitable books based on the contents of the project selected and r	esearch	paper	s from r	eputed							
national	and international journals and conferences.											
Course	Objectives:											
1. Т	1. To acquire the skills of electrical, electronic circuit design and mechanical assembly.											
2. Т	To develop the skills of analysis and fault diagnosis of the electrical, electronic circuit and											
n	hechanical assembly as per design.											
3. Т	o test the electrical, electronic circuit and mechanical assembly.											
Course	Learning Outcomes:											
CO	After the completion of the course the student will be able to	B	loom's	s Cogniti	ve							
		leve	el	Descript	tor							
CO1	Analyze and infer the reference literature/ research papers critically	4		Analyzi	ng							
	and efficiently.											
CO2	Decide the model of the project.	5		Evaluati	ng							
CO3	Construct the project and assess the performance of the project.	6		Creatin	g							
CO4	Write and Present the report of the project.	6		Creatin	ıg							

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1												3	3	3
CO2			3						3		3			
CO3								3					3	3
CO4										3				

Assessment:

There are four components of project assessment, LA1, LA2, LA3 and Project ISE.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks		
LA1	Simulation / Basic	Droiget Denal	During Week 1 to Week 4	25		
	Project design	Project Pallel	Submission at the end of Week 5	23		
I A C	Software /Hardware	Drojact Danal	During Week 5 to Week 8	25		
LAZ	Implementation	Floject Fallel	Submission at the end of Week 9	23		
LA3	Finalize Software	Drojact Danal	During Week 10 to Week 14	25		
	/Hardware Model	Floject Fallel	Submission at the end of Week 14			
Project ISE	Presentation, Project	Project Depol	During Week 15 to Week 18	25		
	report submission	Floject Fallel	Submission at the end of Week 18	25		

Week 1 indicates starting week of Semester. ISE is based on performance of student in project reports, demonstration, presentation, oral, etc. The Project guide/panel shall use at least two assessment tools as mentioned above for ISE.

Course Contents:

- 1. Visit to a local industry for the study of problems of industry.
- 2. Prepare the problem based hardware Mini project.
- 3. Prepare a report on the same.

Module wise Measurable Students Learning Outcomes:

It is expected that students should be able to analyze the problem, work on hardware circuits and prepare the report.

Computer Usage / Lab Tool:

Minor Specialization Courses



Walchand College of Engineering, Sangli (An Autonomous Institute) Minor in Electrical Engineering Structure

	Commo Norma		G 1''	Faculty and its	Available		
Semester		Course Name	Credits	Address	on		
~				Prof. Bhuvaneshwari	ä		
Semester- III	Elect	rical Machines	3	UT Dolhi	Swayam		
				Prof D P Kothari			
Semester- IV	Powe	Power System Generation, 3					
	Trans	smission and Distribution		IIT, Delhi.			
				Prof. Ramkrishna			
Semester- V	Cont	rol Engineering	3	Pasumarthy	NPTEL		
				IIT, Madras.			
	Indus	trial Drives - Power		Prof. K. Gopakumar	NPTEL		
Semester- VI	Elect	ronics	3				
				Drof Sontony			
	Elective I	Microprocessors and		Chattonadhyay	NPTEL		
			3	Chattopadhyay			
		Microcontrollers		IIT, Kharagpur.			
Semester- VII		Electrical Measurement		Prof. Avishek Chatterjee			
		and Electronic	3		NPTEL		
		Instruments		IIT, Kharagpur.			
		Seminar I	1				
		Industrial Automation		Prof. S. Mukhopadhyay			
		and Control	3		NPTEL		
	еП			IIT, Kharagpur.			
Semester- VIII	Elective	Electric Vehicle	3	Prof. Amit Kumar Jain	NPTEL		
			5	IIT, Delhi.			
		Seminar II	1				

Semester	III	IV	V	VI	VII	VIII	Total
Credits	3	3	3	3	4	4	20

Honors Specialization Courses

		Walchand Co	ollege of Engineering, Sangli									
Teaching and Evaluation Scheme effective from 2020-21												
B. Tech in Electrical Engineering with Specialization Electrical Vehicle Technology												
	Teaching Scheme				Evaluation Scheme							
							a]	Marks			
Semester	Code	Name	L	T	Р	Credits	Component	Max Pa		in for assing		
		Com 1. Enour					ISE 1	10				
∽th		Core I: Energy				4	MSE	30		40		
5		Storage Systems for	4			4	ISE 2	10		40		
		EV.					ESE	50	20			
							ISE 1	10				
∠ th		Core 2: Introduction	4			4	MSE	30		40		
0		to Electrical Vehicles	4			4	ISE 2	10		40		
							ESE	50	20			
		Elective 1 Power					ISE 1	10				
		Electronics in					MSE	30				
		Electrical Vehicle /					ISE 2	10				
7 th		Case studies in EV Development,	4			4	ESE	50	20	40		
		Elective 2 EV					ISE 1	10				
		Technology and Grid					MSE	30				
		management /					ISE 2	10				
8 th		Artificial Intelligence in EV / Computer aided Vehicle design.	4			4	ESE	50	20	40		
8 th		Mini Project	2			2	ISE ESE	50 50	20 20	40		
		Total	18			18	Total	Credit	s: 18	o		
						Total Co	ontact	Hrs:1	ð			

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