Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Electrical Engineering

Faculty of Science and Technology



Syllabus Structure Semester - VII and VIII w. e. f. 2020 – 21

		Tagghing Schome				Evaluation Scheme					
			reaching	Scheme		Theo	ory	Pra	ctical		
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits
Electrical Drives	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -III	E	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -IV	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course – III	F	3	-	-	3	40	60	-	-	100	3
Electrical Drives Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
MATLAB and its applications	D	1	-	2	3	-	-	25	25(OR)	50	2
Project (Stage -I)	G	-	-	12	12	-	-	50	50(OR)	100	6
Essence of Indian Traditional Knowledge	Н	-	-	-	-	-	-	-	-	-	-
		13		16	29	160	240	100	100	600	21

Syllabus Structure for Final Year Engineering (Semester – VII) (Electrical) (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

	Professional Elective Course – III		Professional Elective Course – IV	Open Elective Course – III		
1	Electrical Energy Conservation and Auditing	1	Power System Dynamics and Control	1	VLSI Design and Technology	
2	Electrical Machines Modelling and Analysis	2	Power Electronics and Distributed Generation	2	Artificial Intelligence	
3	Power Generation and Economics	3	Industrial Electrical Systems	3	Virtual Reality	
4	Digital Control System	4	Power System Design Practice	4	Bio-Medical Instrumentation	

		Tooching Schome				Evaluation Scheme					
		reaching Scheme				Theory		Practical			
Name of the Course	Group	Theory Hrs / week	Tutorial Hrs / week	Practical Hrs / week	Total	ISE	ESE	ICA	ESE	Total	Credits
Power System Protection	D	3	-	-	3	40	60	-	-	100	3
Professional Elective Course - V	Е	3	-	-	3	40	60	-	-	100	3
Professional Elective Course -VI	E	3	-	-	3	40	60	-	-	100	3
Open Elective Course - IV	F	3	-	-	3	40	60	-	-	100	3
Power System Protection Lab	D	-	-	2	2	-	-	25	25(PR)	50	1
High Voltage Laboratory	D	2	-	2	4	-	-	25	25(OR)	50	3
Project	G		-	6	6	-	-	50	50(OR)	100	3
		14	0	10	24	160	240	100	100	600	19

Syllabus Structure for Final Year Engineering (Semester – VIII) (Electrical) (w.e.f. 2020 – 21)

ISE: Internal Sessional Examination

ESE: End Semester Examination

ICA: Internal Continuous Assessment

Professional Elective Course – V			rofessional Elective Course – VI	Open Elective Course – IV		
1	Flexible AC Transmission System & Power Quality	1	Electric and Hybrid Vehicles	1	Digital Signal Processing	
2	Power Converter Applications	2	Advanced Electric Drives	2	Embedded System	
3	HVDC Transmission Systems	3	EHVAC Transmission Systems	3	Robotics	
4	Power System Restructuring	4	Illumination Engineering	4	Cyber Security	

Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Electrical Engineering

Faculty of Science and Technology



COURSE OUTLINE

Semester – VII

w. e. f. 2020 – 21

	Electrical Drives									
0				COURSE	OUTLIN	E	DD	G		
Course	Electrica	I Drives				Short	ED	Cou	rse	
Title:	•					l itle:		Cod	e:	
Course d	Course description:									
The course aims to give a broad view of Electrical Drive System. It is considered that students have prior										
knowledge of Electrical Machines and Power Electronics. The control principles for AC and DC motors										
applicatio	applications related to AC and DC drives are also highlighted									
I octure	ons related		c urives		wooka	Tote	al hour	- Sor	noste	n anadita
Lecture		Hours/week No. of weeks			weeks	100		s Sei		
	•.	03		1	4		42		(13
Prerequi	site course	$\frac{e(s)}{C}$	· D	F1 (· ·					
Electrical	Machines,	Control Sys	tems, Po	ower Elect	ronics					
Course o	bjectives:	0.1	• • •	1			1		1	1
The main	objective of	of the course	is to: A	nalyze mos	st of the wi	idely used	d conve	rters for ac	and	le motors,
Understar	nd perform	ance of conv	verter fe	d AC and	DC motor	's and its	speed	torque cha	acter	ristics and
learn vari	learn various control methods for ac and dc drive.									
Course outcomes:										
After successful completion of this course the student will be able to:										
1. Select a drive for a particular application based on power rating.										
2. Sel	ect a drive	based on me	chanical	character	istics for a	particula	ir drive		•	
3. Op	erate and n	laintain solid	state dr	ives for sp	eed contro	1 of useria	and AC	machines.	.1	lain
4. Op 5. Ida	erate and n	alla at AC duix	state or	ives for sp	eed contro	of of vario	bus spec	al electric	ai ma	achines
J. 100	inity and so	elect AC un	les for u	interent ap	plications.					
			(COURSE	CONTEN	T				
Electrica	l Drives				Semester	r:		VII		
Teaching	Scheme:				Examina	ation sch	eme			
Lectures	,	3 hou	rs/week		End Sen	nester Ex	xam (ES	SE):	(50 marks
	-				Duratio	n of ESE		-)-	()3 hours
					Internal	Sessiona	al Exan	ns (ISE):	4	40 marks
	Unit_I:		No	, of Lectu	res: 08 Hc	ours		Marks	: 12	
Fundame	entals of	Electric Dr	rive: El	ectric Dri	ves and	its parts	. advar	tages of	elect	ric drives
Classifica	tion of elec	ctric drives S	peed-tor	aue conve	ntions and	multi-au	adrant c	perations (Const	ant torque
and const	ant power	operation Tv	pes of lo	ad torque	compone	nts. natur	e and cl	assificatio	1.	4.00
and constant power operation Types of four torque, components, nature and classification.										
Unit–II: No. of Lectures: 08 Hours Marks: 12										
Dynamics of Electric Drive: Dynamics of motor-load combination Steady state stability of Electric										
Drive Tra	insient stab	ility of electi	ric Drive	e Selection	of Motor	Power ra	ting: Th	ermal mod	el of	motor for
heating a	nd cooling	, classes of r	notor du	ıty, detern	nination of	motor p	ower ra	ting for co	ntinu	10us duty,
short time	e duty and	intermittent c	luty. Loa	ad equaliza	ation.	-				

Unit–III:	No. of Lectures: 08 Hours	Marks: 12						
Electric Braking: Purpose and t	ypes of electric braking, braking of	of DC, three phase induction and						
synchronous motors Dynamics du	ring Starting and Braking: Calculati	on of acceleration time and energy						
loss during starting of DC shunt	and three phase induction motors,	methods of reducing energy loss						
during starting. Energy relations d	uring braking, dynamics during bra	king.						
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12						
Power Electronic Control of D	C Drives: Single phase and three	e phase controlled converter fed						
separately excited DC motor drive	s (continuous conduction only), du	al converter fed separately excited						
DC motor drive, rectifier control	of DC series motor. Supply harme	onics, power factor and ripples in						
motor current Chopper control of	separately excited DC motor and D	C series motor.						
Unit–V:	No. of Lectures: 09 Hours	Marks: 12						
Power Electronic Control of AC Drives: Three Phase induction Motor Drive: Static Voltage control								
scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance								
and slip power recovery control schemes. Three Phase Synchronous motor: Self controlled scheme								
Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular								
applications.								
Text Books:								
1. G.K. Dubey, "Fundamentals	of Electric Drives", Narosa publish	ing House, 2 nd edition, 2002.						
2. S.K. Pillai, "A First Course or	Electric Drives", New Age Interna	tional Publishers, 3 rd edition, 2012.						
3. B.N. Sarkar, "Fundamental o	f Industrial Drives", Prentice Hall o	of India Ltd., 2012.						
Reference Books:								
1. M. Chilkin, "Electric Drives"	', Mir Publishers, Moscow.							
2. Mohammed A. El-Sharkaw	2. Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd.							
Singapore, 2 nd edition, 2017.								
3. N. K. De, Prashant K. Sen, "	Electric Drives", Prentice Hall of In	dia Ltd., 2014.						
4. V. Subrahmanyam, "Electric	Drives: Concepts and Applications	", Tata McGraw Hill, 1994.						

H	Electrical Energy Conservation and Auditing (Professional Elective Course – III)								
		(COURSE OUTLIN	E					
Course Title:	Electrica	l Energy Conservati	Short Title:	EECA	Course Code:				
Course description: The course explores the knowledge of current energy Scenario, sources of primary									
energy ar	nd Scope of	of conservation in vie	ew of environment a	and clima	te change. 7	This course	provides		
knowledg	ge of lim	ited conventional er	nergy generation, e	energy a	udit and co	onservation	, Energy		
Conserva	tion Act, e	nergy efficient motors	s and other electrical	gazed, sc	ope of energy	y saving in	domestic,		
industrial	, agricultu	res sectors and demai	nd side management	ts .Energ	y conservation	on is mand	atory and		
answerab	le to next g	generation.							
Lecture		Hours/week No. of weeks Total hours Semester cred					r credits		
		03	14		42	0	3		
Prerequi	site course	e(s):							
Course of	objectives	The Objectives of	subject are to un	derstand	the need of	f energy a	audit and		
conservat	tion, social	and environmental ca	use as per Energy co	nservatio	n Act. Stude	nts will abl	e to know		
the metho	dology of	energy audit for indus	tries and priority of a	ction pla	n Students w	ill able to u	nderstand		
scope den	nand side 1	nanagement, energy e	efficient motor and e	nergy coi	servation in	motors, lig	hting and		
refrigerat	ion. Stude	nts will able to do e	energy performance	assessm	ent of electr	ical install	ation and		
understand the financial analysis for energy audit like payback period.									
	r.,								
Course o	utcomes:								
After suc	cessful cor	nulletion of this course	e the student will be	able to:					

- 1. Understand the current energy scenario and importance of energy conservation in view of social and environmental cause.
- 2. Apply basic knowledge of engineering to understand need of energy audit, identify methods, and analyze technical and economic feasibility. Also able to summarize all possible suggestion for fruitful results.
- 3. Identify methods for energy management by IT tools including prediction and modeling to complex engineering problems, analyze the energy data and electric tariff for implementation of demand side management in every sector of consumer.
- 4. Conduct an investigation the consumption in motive, illumination, heating and cooling system for conserving electrical energy by professional and ethical way and able to solve complex engineering problems.
- 5. Apply appropriate techniques, resources, for analyzing performance assessment of motors. Cooling system, pumps and lighting system. Students also able to recognized the importance of financial analysis.

Electrical Energy Conservation and Auditing						
COURSE CONTENT						
Electrical Energy Conservation and Auditing	Semester:	VII				
Teaching Scheme: Examination scheme						

Lectures:	3 hours	s/week	End Semester E	Exam (ESE):	60 marks			
			Duration of ESE:		03 hours			
			Internal Sessior	nal Exams (ISE):	40 marks			
Unit–I:		No. of Lectu	res: 09 Hours	Marks: 12	2			
Energy Scenario and S	Scope of	conservation:	Commercial and	Non-commercial ener	mmercial energy, primary			
energy resources, commercial energy production, final energy consumption, energy needs of growing								
economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment,								
energy security, energy conservation and its importance, energy strategy for the future, Energy								
Conservation Act-2001 a	nd its fea	tures. Progress m	ade in energy cons	servation in India. Sco	pe of energy			
conservation in different	sectors							
Unit–II:		No. of Lectu	res: 08 Hours	Marks: 12	2			
Energy Audit: Principle	s of ener	gy audit, type an	d methodology of	f energy audit: prelimit	nary energy			
audit and detailed energy	⁷ audit, p	rocedures of carr	ying out energy a	udit, energy audit imp	lementation			
priority, understanding en	nergy cos	st, bench marking	g energy performa	ance, fuel and energy	substitution,			
energy audit report writin	ıg, instru	ments used for en	ergy audit.					
		1						
Unit–III:		No. of Lectu	res: 08 Hours	Marks: 12	2			
Energy Management :(Concept of	of energy manage	ement ,review of 1	load and utilization fac	ctors, bench			
marking, fuel and energy substitution , power factor improvement, power demand monitoring. Impact								
of electric tariff on energy	y manage	ement. Billing me	ethods Concept of	demand side managem	ient (DSM),			
scope of DSM, Load con	trol meth	nods, DSM plann	ing and implement	ntation, load management	ent as DSM			
strategy Advantages of D	SM to co	onsumers, utility a	and society.					
		Γ						
Unit–IV:		No. of Lectu	res: 09 Hours	Marks: 12	2			
Energy Efficiency and (Conserva	tion: Motive pov	ver: potential for s	aving electrical energy	in motors -			
over sizing or under load	ing, imp	roving efficiency	of an existing mo	tor, energy efficient m	otor, use of			
variable or adjustable sp	eed drive	es for energy cor	servation, effect	of rewinding on perfo	rmance and			
consumption. Transforme	er losses,	energy efficient	transformer and e	energy efficiency ratin	g. Lighting:			
level of illumination for	different	areas. Use of rig	sht source of lamp	for different applicati	ons, energy			
efficient lamps, energy of	conservat	ion scope in ligh	nting system Ener	gy efficiency in air c	onditioning,			
control strategies and ene	rgy cons	ervation opportur	nities					
		Γ		1				
Unit–V:		No. of Lectu	res: 08 Hours	Marks: 12	2			
Performance Assessme	nt: Ener	gy performance	assessment of va	riable speed drives, p	performance			
terms, points for user, ter	sting peri	formance evolution	ons, format for da	ta collection. Energy p	performance			
assessment of refrigeration and air conditioning system, performance terms, performance evolutions.								
Energy performance assessment of water pumps. Energy performance assessment of lighting system.								
Financial analysis.								
Text Books:								
1. Umesh Rathore, "E	nergy M	anagement", S. K	. Kataria and Son	s, 2 nd Edition, 2014.				
2. S. C. Tripathy, "Ele	ectrical E	Inergy Utilization	and Conservation	i",Tata McGraw-Hill, 1	1991.			

- 1. Guide books for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects (online).
- 2. Guide books for National Certification Examination for Energy Manager/Energy Auditors Book-3, Electrical Utilities (online)
- 3. Success stories of Energy Conservation by BEE, New Delhi (<u>www.bee-india.org</u>)
- 4. B. E. Kushare, "Hand Book on Energy Efficient Motors", International Cooper Proposition Council.

	Electrical	Machines Mo	odelling a	nd Ana	lysis (Pro	fessiona	l Elective C	ourse – I	(I)
COUDSE OUT INF									
Course Title:	Electrica	al Machines M	Iodelling	and An	alysis	E Short Title:	EMMA	Course Code:	
Course d	escriptior	1:						·	÷
Lecture		Hours/we	ek	No. of	weeks	Tot	al hours	Semes	ter credits
Prerequi	site cours	e(s):							
Electrical	Machines	s-I and II							
Course o	bjectives:	· · · /	• 1 . (1	1	· T 1	(1 1	· 1' (· 1'	1 1'
The object	ctive of th	is course is to	provide ti	he stude	Ents In-dep	pth unde	rstanding of	generaliz	ed machine
theory wi	n mothom	the dasis of N	of mochine		g. Explore	the conc	tiotion to d	ormation	of variables
to develo	p mathem	hatical model	of machin	nes. It	provides	good ini 1 control	of electrice	evelop M 1 maabina	
	for high n	ysis. The conc	vos An ir	. dopth	ovnosuro :	to the ve		lont circui	willen are
essential for high performance drives. An in-depth exposure to the various equivalent circuits and their									
Course outcomes:									
After successful completion of this course the student will be able to:									
1. Explain generalized theory of electrical machines									
2. Apply linear transformations to Electrical machines									
3. De	3. Develop mathematical models of DC machines and its analysis under normal and perturbation								
4. De	velop mat	hematical mo	dels of sy	ynchron	ous mach	ines and	l its analysi	is under 1	normal and
per	turbation.								
5. De	velop mat	thematical mo	dels of i	inductio	n machir	nes and	its analysis	s under r	ormal and
per	turbation.								
			CO	URSE	CONTEN	T			
Electrica	l Machine	es Modelling a	and Analy	sis	Semeste	r:	VI	Ι	
Teaching	g Scheme:				Examina	ation sch	eme		
Lectures	:	3 hours	s/week		End Sen	nester Ex	xam (ESE):		60 marks
					Duration	n of ESE	•		03 hours
	Internal Sessional Exams (ISE): 40 marks							40 marks	
	Unit–I: No. of Lectures: 09 Hours Marks: 12								
Basic Pri	inciples of	f Electrical M	achine A	nalysis:	Magnetic	cally Cou	pled Circui	ts, Electro	mechanical
Energy C	onversion,	, Machine Win	dings and	Air-gap	MMF, W	'inding Ir	ductances a	nd Voltag	e equations,
basic two pole machine, per unit system, transformer with movable secondary, analysis of electrical									
machine.	machine.								
	TT- •4 TT	r.		PT - 4		T		M1 14	•
	Unit–II: No. of Lectures: 09 Hours Marks: 12							<i>i</i>	

Linear Transformation in Machines: Invariance of Power, transformation from a displaced brush axis, transformation from three phase to phase, transformation from rotating axis to stationary axis, physical concept of Park's transformation, apply generalized theory to electrical machines.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12					
Modelling and Analysis of DC Machines: Separately excited dc generator and motor, interconnection							
of machines, transfer function of dc machine (DC Series and DC Shunt), linearization techniques for							
small perturbation and electrical b	raking of DC motor.						

Unit–IV: No	o. of Lectures: 08 Hours	Marks: 12
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Modelling and Analysis of Synchronous Machine: Basic synchronous machine parameters, general machine equations, balance steady state analysis, steady state power angle analysis, short circuit ratio, transient analysis, transient analysis a qualitative approach, transient reactance and time constant from equivalent circuit, transient power angle characteristics.

Unit–V: No. of Lectures: 08 Hours Marks: 12

Modelling and Analysis of polyphone Induction Machine :Electrical performance equations, analysis of equivalent circuit, torque slip characteristic, effect of voltage and frequency variation on performance, operation under unbalance, effect of space harmonics on performance and analysis.

Text Books:

 P.S. Bimbhra, "The Generalised Theory of Electrical Machines", Khanna Publishers, 6th Edition, 2011.

- 1. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 6th Edition, 2013.
- 2. E. Clayton, N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 3rd Edition, 2004.
- 3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 3rd Edition, 2002.
- 4. J. Nagrath, D. P. Kothari, "Electric Machines", McGraw Hill Education, 4th Edition, 2010.
- 5. P.C. Krause, "Analysis of Electric Machinery", McGraw Hill, NY, 3rd Edition, 1987
- 6. C.V. Jones, "The unified Theory of Electrical Machines", Butterworth-London, 1967
- 7. Dhar R.N., "Computer Aided Power System Operation and Analysis", Tata McGraw Hill

	Powe	r Generation a	nd Economics	(Professio	onal Elec	tive Course	e – III)	
			COURSE	OUTLIN	E			
Course	Power G	eneration and E	Conomics		Short	PGE	Course	
Title:					Title:		Code:	
Course d	Course description:							
This cour	se provide	s an introduction	to power gen	eration by	using co	nventional	sources. T	his course
covers th	e working,	selection of site	e, different ele	ments of	various c	conventiona	l power pl	ants. This
course als	so provides	an introduction	to the economi	cs conside	ration of	the power j	plants.	
Lecture	-	Hours/week	No. of	weeks	Tota	al hours	Semest	er credits
		03	1	4		42		03
Prerequisite course(s):								
Power Sy	stem-I, Pov	wer System-II						
Course o	bjectives:							
The object	ctives of the	is subject are that	at students will	be able to	understa	anding the v	vorking, se	election of
site, diffe	rent eleme	nts, and general	arrangement of	of Hydro I	Power pla	ants, Therm	al Power j	plants and
Nuclear p	ower plant	ts. The objective	s of this subje	ct are that	students	will be abl	e to under	stand cost
analysis,	effects of	various loads of	on power syste	em, load s	sharing.	Choice of	size and r	umber of
generatin	g plants. T	he students will	able to under	stand effect	et of pow	ver factor of	n power sy	ystem and
methods t	o improve	power factor.						
~								
Course o	utcomes:	mlation of this a	ourse the stude	nt will be	abla tar			
After suc		ipietion of this c	ourse the stude		able to:			
I. Exp	blain the ar	rangement and o	peration of hyd	1 D	power p	lant.		
2. Exp	blain the ar	rangement and w	vorking of The	rmal Powe	er plants.			
3. Exp	plain the ar	rangement and w	vorking of Nuc	lear Power	r plant.			
4. Det	fine cost an	alysis of power	plants.					
5. Det	fine effects	of power factor	on power syste	em and me	thods for	improving	the power	factor.
				~~~				
D C			COURSE	CONTEN	T		<b>T</b>	
Power G	eneration a	and Economics		Semester	r:	VI	1	
Teaching	Scheme:			Examina	ation sch	eme		(0 1
Lectures		3 hours/w	eek	End Sen	nester Ex	am (ESE):		60 marks
				Duration	n of ESE	:		03 hours
Internal Sessional Exams (ISE): 40 mar				40 marks				
	Unit–I: No. of Lectures: 08 Hours Marks: 12							
Hydroele	Hydroelectric Power Plant: Hydrology, run off and stream flow, hydrograph, flow duration curve,							
Mass cur	ve, reservo	ir capacity, dam	storage. Hydr	ological cy	ycle, mer	its and dem	nerits of hy	droelectric
power pla	ints, Select	ion of site. Gene	ral arrangemen	t of hydel	plant, ele	ements of th	e plant, Cl	assification
of the plants based on water flow regulation, water head and type of load the plant has to supply. Water								

turbines– Pelton wheel, Francis, Kaplan and propeller turbines. Characteristic of water turbines Governing of turbines, selection of water turbines. Underground, small hydro and pumped storage plants. Choice of size and number of units, plant layout and auxiliaries.

Unit–II:	No. of Lectures: 09 Hours	Marks: 12				
Thermal Power Plant: Introducti	on, Efficiency of steam plants, Mer	ts and demerits of plants, selection				
of site. Working of steam plant,	Power plant equipment and layout	t, Steam turbines, Fuels and fuel				
handling, Fuel combustion and combustion equipment, Coal burners, Fluidized bed combustion,						
Combustion control, Ash handling, Dust collection, Draught systems, Feed water, Steam power plant						
controls, plant auxiliaries.						
Diesel Power Plant: Introduction	, Merits and demerits, selection sit	e, elements of diesel power plant,				
applications.						
Unit-III:	No. of Lectures: 08 Hours	Marks: 12				
Nuclear Power Plants: Introduct	tion, Economics of nuclear plants,	Merits and demerits, selection of				
site. Nuclear reaction. Nuclear fis	sion process. Nuclear chain reaction	on. Nuclear energy. Nuclear fuels.				
Nuclear plant and layout. Nuclear	r reactor and its control. Classifica	tion of reactors, power reactors in				
use Effects of nuclear plants Dis	posal of nuclear waste and effluent	shielding				
Unit_IV:	No. of Lectures: 09 Hours	Marks: 12				
Economics Considerations I: I	ntroduction classification of costs	Cost analysis of power plants				
Interest and Depreciation Method	is of determination of depreciation	- Diminishing Value or Declining				
method Sinking fund method. Ea	onomics of Power generation Effect	t of variable load on power system				
different terms considered for po	wor plants and their significance	load sharing. Choice of size and				
number of concreting plants and n	wer plants and then significance,	foad sharing. Choice of size and				
	umencai.					
TI \$4 \$7.	N	Maalaa 10				
	No. of Lectures: 08 Hours					
Economics Considerations II: 13	ariffs, objective, factors affecting th	e tariff, types. Types of consumers				
and their tariff. Power factor, disa	dvantages of low power factor, can	ises of low power factor, methods				
of power factor improvement, Lo	ocation of Power factor correction	equipment, Advantages of power				
factor improvement, economics of	power factor improvement and co	mparison of methods of increasing				
power supplied, Choice of equipm	ient.					
Text Books:						
1. B.R. Gupta, "Generation of	Electrical Energy", Eurasia Publish	ing House (Pvt.) Ltd, Seventh				
Edition, 2017.						
2. J.B. Gupta, "A Course in Electric Power", S.K. Kataria and Sons, Fourteenth Edition, 2013.						
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<b>Reference Books:</b>						
1. Olle L. Elgerd, "Electrical End	ergy System Theory, An Introduction	on", McGraw Hill, Second				
Edition, 2017.						
2. D.P. Kothari, I.J. Nagrath, "Modern Power System Analysis". Tata McGraw Hill Education.						
Fourth Edition, 2011.						

- William D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 4th Edition, 1985.
- 4. Leon K. Kirchmayer, "Economic Operation of Power Systems", Wiley India Pvt. Ltd, 2009.
- 5. C. L. Wadhwa, "Electrical Power System Analysis", New Age International Publication, Seventh Edition, 2017.
- 6. Hadi Saadat, "Power System Analysis", Tata McGraw Hill, 2nd Edition, 2009.
- 7. A. Chakrabarti, M.L. Soni, P.V. Gupta & U.S. Bhatnagar, "A Text Book on Power System Engineering", Dhanpat Rai & Co. limited, 2016.
- 8. S. N. Singh, "Electric Power Generation: Transmission and Distribution", PHI Learning, 2nd Edition, 2008.
- 9. Tanmoy Deb, "Electrical Power Generation", Khanna Publishing House, 1st Edition, 2018.
- 10. http://nptel.iitm.ac.in

Digital Control System (Professional Elective Course – III)							
COURSE OUTLIN	E	<b>D</b> 00					
Course Digital Control System	Short	DCS	Course				
	Title:		Code:				
Course description:							
Digital control is a branch of control theory that uses digital computers as system controllers. This							
course provides the knowledge about the basic signals, state space analysis, different methods used for							
stability analysis. This course designed to introduce to the s	students ba	isic design	n and Appl	ications of			
Lasting Hours/weak No. of weaks	Total	hound	Comost	on anadita			
Lecture Hours/week No. of weeks	Total	nours	Semest				
03 14	4	2		03			
Prerequisite course(s):							
Signals and systems, control system.							
Course objectives:	C 1'	1 1 1		<b>TD1</b>			
Digital controllers are used in a wide variety of systems range	ng from di	SK drives	to aircrafts.	I hus, it is			
very important to be well-versed in the analysis and design chiesting include equipping students with 1. Understanding	n of digita		systems. I	tal control			
systems such as affacts of discrete time signals and models	2 Design	s issues re	lanea to dig	nal control			
controllers. The digital controllers will also take into account	, 2. Design	ical impl	amontation	issues like			
aliasing and quantization to achieve the desired performance s	n ne praci	near mipic	ementation	issues like			
	specificatio	5115.					
Course outcomes:							
After successful completion of this course the student will be	able to:						
1. To make students understand basic concepts of discrete si	ignals and	systems.					
2. To understand the concept of state and to be able to repres	sent a syste	em in the	state space	format			
and to solve the state equation and familiarize with STM	and its pro	perties.					
3. To educate students to analyze the stability of digital systematical systematica	ems.	<b>F</b>					
4. To be able to analyze and design a digital control system	including 1	ealization	n of digital c	controllers.			
5. To explore application of the theory of digital control to p	oractical pr	oblems.	C				
	-						
COURSE CONTEN	T						
Digital Control System Semester	r:	V	II				
Teaching Scheme: Examina	Examination scheme						
Lectures: 3 hours/week End Sen	nester Exa	m (ESE)	:	60 marks			
Duration	n of ESE:			03 hours			
Internal	Internal Sessional Exams (ISE):			40 marks			
Unit–I: No. of Lectures: 08 Hours Marks: 12							

**Discrete systems and Signals** Standard discrete test signals, Basic operations on signals, Classification of discrete systems, Detail analysis of frequency aliasing & quantization, Brief review of Sampling theorem, Z-transform, Laplace transform and Fourier transform, Transfer function of ZOH, Frequency domain characteristics of ZOH.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12		
State - Space analysis: Solution	of LTI Discrete -time state equation	on, State Transition Matrix (STM)		
and properties of STM, Computation	on of STM by Z-transform method,	by power series expansion method,		
by Cayley Hamilton theorem, by Similarity transformation method, Discretization of continuous time				
state space equation.				

Unit–III: No. of Lectures: 09 Hours Marks: 12
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**Stability Analysis:** Pulse transfer function, Mapping between S-plane and Z-plane, Stability analysis of closed loop system in the Z-Plane, Jury's stability test, Nyquist stability criteria, Lyapunov stability theorem, Stability analysis by use of Bilinear transformation & Routh-Hurwitz Stability Criterion, Digital compensator design using frequency response (Bode plot).

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12		
<b>Design of Digital Control Syste</b>	<b>m:</b> Introduction to PID controller.	individual effect of Proportiona		

controller, Integral controller and Derivative controller on overall system performance, Concepts of Controllability and observability, Effect of pole- zero cancellation on controllability and observability of the system. Pole placement design by state variable feedback, Necessity of observer, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag compensator design in frequency domain.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12

**Applications of Digital Control System:** Digital temperature control - first order temperature system, process model, design of PID controller, control law for temperature control. Position control-position control system, position control system using speed feedback.

### **Text Books:**

- 1. K. Ogata, "Modern Control Engineering", Prentice Hall of India Pvt. Ltd., 5th edition, 2015.
- J. Nagrath, M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2009.

- 1. Astrom Karl Johan and Wittenmark Bjorn, "Computer-Controlled Systems: Theory and Design", Prentice-Hall, 3rd Edition, 2011.
- 2. M. Gopal, "Digital Control Engineering", New age international pvt.ltd, 2nd Edition, 2014.
- 3. Kuo B. C., "Automatic Control System", Prentice Hall, 7th edition, 2001.

	Power System Dynamics and Control (Professional Elective Course – IV)						
	COURSE OUTLINE						
Course	Power S	ystem Dynamics and	l Control	Short	PSDC	Course	
Title:				Title:		Code:	
Course d	escription	1:					
Modern p	ower syst	ems have grown larg	er, expanding over v	vide geog	graphical are	ea. Interconi	nection of
grids has	led to more	e complex operationa	l problems. Such larg	ge system	s require ver	y advance c	omputing
facilities	and techni	iques. This course ex	plores knowledge o	f econom	ic load sche	eduling and	dispatch.
The cours	se provides	s knowledge of power	system operation ar	d control	, need and in	mportant, vo	oltage and
frequency	control.	The course also provid	des knowledge of ste	ady state	and transier	nt stability o	of a power
system.		<b></b>					1.
Lecture		Hours/week	No. of weeks	Tota	al hours	Semeste	r credits
		03	14		42	0	3
Prerequi	site cours	e(s):					
Power Sy	stem-I, Po	ower System-II					
Course o	bjectives:						
The object	ctives of the	his course are to stud	ly about the econom	ic load d	ispatch and	optimal op	eration of
power sy	vstem. In	this course knowled	lge of Automatic v	oltage co	ontrol, excit	ation system	ms, static
performa	nceanddyi	namic response of AV	R loops should be p	rovided.	The course o	bjectives ar	e to study
about the	Autom	atic load frequency c	ontrol, Concept of c	ontrol ar	ea. In this c	course we w	will try to
understar	d how to a	ssess the stability of	a power system, how	to impro	ve the stabil	lity and fina	lly how to
prevent s	ystem becc	oming unstable.					
Course o	utcomes:	1	<u>, , , , , , , , , , , , , , , , , , , </u>	11 /			
After suc	cessful coi	mpletion of this cours	e the student will be	able to:	1 1 1 .	1	
I. Kno	w the opt	imal load schedulin	g, function & oper	ation of	load dispate	ch centre f	or
ecor	iomic grov	vth of electric utilities		1	1		. 1
2. Kno	w the con	cept of automatic vol	itage control, their r	natnemat	ical modelin	ig, static ai	10
dyna 2 Kno	annic analys	SIS.	control mothematic	al modal	ina statia	and dynam	
J. KIIO	w life col	ale area system	control, mathematic	al model	ing, static	and uynam	IC
response of single area system.							
<ul> <li>4. Describe steady state stability of a power system</li> <li>5. Describe transient stability of a power system</li> </ul>							
5. Describe transient stability of a power system.							
COURSE CONTENT							
Power Sy	ystem Dvn	namics and Control	Semeste	r:	VI	I	
Teaching	Scheme:		Examina	ation sch	eme		
	,						

Duration of ESE:         03 hours           Internal Sessional Exams (ISE):         40 marks           Unit-1:         No. of Lectures: 08 Hours         Marks: 12           Economic Load Dispatch & Optimal Operation of Power System: Input Output characteristics, Heat- rate characteristics, Incremental fuel rate and cost, Incremental production cost, optimum scheduling of generation between different units. (Neglecting transmission losses), Transmission loss as a function of plant generation (A simple system connection two generating plants to load) and incremental transmission loss for optimum economy, Calculation of loss coefficients (Two plant system), Optimum scheduling of generation between different plants considering transmission loss concept and significance of penalty factor, Automatic load dispatch, function and applications.           Unit-II:         No. of Lectures: 08 Hours         Marks: 12           Generator Voltage Control: Automatic voltage control, generator controllers, Cross coupling between P- f and Q-V control channel, automatic voltage regulator, types of exciters and excitation systems, exciter modeling, transfer function modeling for control static performance and/ynamic response of AVR loops.           Unit-III:         No. of Lectures: 09 Hours         Marks: 12           Load Frequency Control: Automatic load frequency control, speed governing system and hydraulic valve actuator for individual generator, Turbine modeling, generator and load modeling, transfer function representation of power control mechanism of generator. Load frequency of single areas power system with and without integral controls. Introduction to pool operation.           Unit-IV:         No. of Lectures:	Lectures:	3 hours	s/week	End Semester Exam (ESE):60 marks				
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Unit–III:No. of Lectures: 09 HoursMarks: 12Load Frequency Control: Automatic load frequency control, speed governing system and hydraulic valve actuator for individual generator, Turbine modeling, generator and load modeling, transfer function representation of power control mechanism of generator. Load frequency of single areas power system with and without integral controls. Introduction to pool operation.Unit–IV:No. of Lectures: 08 HoursMarks: 12Introduction: Meaning of stability, types of stability, rotor angle of synchronous machines, voltage and frequency stabilityMarks: 12Steady State Stability: Steady state stability limit, Effects of losses on steady state stability, Effect of inertia on steady state stability, Effect of automatic voltage regulator, calculation of steady state stability limit, methods to improve SSSL.Marks: 12Transient Stability: Meaning of transient stability, Sudden short circuit on synchronous machine and reactances. Assumptions made for swing equation, swing equation, shortcoming of classical model, Equal area criterion, Critical clearing angle and time, sudden short circuit on one of parallel transmission line, methods to improve transient stability.Text Books: 1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017. 2. E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.	modeling, transfer function modeling for control static performance and dynamic response of AVR loops.							
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with and without integral controls. Introduction to pool operation.         Unit–IV:       No. of Lectures: 08 Hours       Marks: 12         Introduction: Meaning of stability, types of stability, rotor angle of synchronous machines, voltage and frequency stability       Steady State Stability: Steady state stability limit, Effects of losses on steady state stability, Effect of inertia on steady state stability, Effect of automatic voltage regulator, calculation of steady state stability limit, methods to improve SSSL.         Unit–V:       No. of Lectures: 09 Hours       Marks: 12         Transient Stability: Meaning of transient stability, Sudden short circuit on synchronous machine and reactances. Assumptions made for swing equation, swing equation, shortcoming of classical model, Equal area criterion, Critical clearing angle and time, sudden short circuit on one of parallel transmission line, methods to improve transient stability.         Text Books:       1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.         2. E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.	representation of power c	control m	hechanism of gene	erator. Load frequ	ency of single areas po	ower system		
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Interpretability         Steady State Stability         Steady State Stability: Steady state stability limit, Effects of losses on steady state stability, Effect of inertia on steady state stability, Effect of automatic voltage regulator, calculation of steady state stability limit, methods to improve SSSL.         Unit–V: No. of Lectures: 09 Hours Marks: 12         Transient Stability: Meaning of transient stability, Sudden short circuit on synchronous machine and reactances. Assumptions made for swing equation, swing equation, shortcoming of classical model, Equal area criterion, Critical clearing angle and time, sudden short circuit on one of parallel transmission line, methods to improve transient stability.         Text Books:         1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.         2. E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.	<b>Introduction:</b> Meaning of	of stabilit	y, types of stabili	ty, rotor angle of s	ynchronous machines,	voltage and		
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Intertia on steady state stability, Effect of automatic voltage regulator, calculation of steady state stability limit, methods to improve SSSL.         Unit–V:       No. of Lectures: 09 Hours       Marks: 12         Transient Stability: Meaning of transient stability, Sudden short circuit on synchronous machine and reactances. Assumptions made for swing equation, swing equation, shortcoming of classical model, Equal area criterion, Critical clearing angle and time, sudden short circuit on one of parallel transmission line, methods to improve transient stability.         Text Books:       Image: Colspan="2">1. Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.         2. E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.	Steady State Stability: S	Steady st	ate stability limit.	, Effects of losses	on steady state stabilit	ty, Effect of		
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<ol> <li>Olle L. Elgerd, "Electrical Energy System Theory, An Introduction", McGraw Hill, Second Edition, 2017.</li> <li>E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.</li> </ol>								
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<ol> <li>E.W. Kimbark, "Power System Stability", Vol. I, II, III, Wiley-Blackwell, 1995.</li> </ol>	I. Olle L. Elgerd, Elec	uncai En	ergy System Theo	ory, An Introductio	on , McGraw Hill, Sec	ond		
2. E. W. Kindark, Power System Stability, Vol. 1, 11, 11, Whey-Blackweil, 1995.	Edition, 2017.							
	2. E.W. KIIIDark, POW	er Syster	in Stability, vol.	1, 11, 111, wпеу-в	lackwell, 1995.			
Reference Books	Reference Rooke							
1 D P Kothari I I Nagrath "Modern Power System Analysis" Tata McGraw Hill Education Fourth								
1. D. 1. Koman, 1. J. Magram, Wouch Fower System Analysis, Tata Weolaw Hin Education, Fourth	1. D. I. Kouldil, I. J. Na	gram, N	Nouch rower sys	, 18				

Edition, 2011

- 2. William D. Stevenson, "Elements of Power System Analysis", Tata McGraw Hill, 4th Edition, 1985.
- 3. C. L. Wadhwa, "Electrical Power System Analysis", New Age International Publication, Seventh Edition, 2016
- 4. Dr. K. Uma Rao, "Power System Operation and Control", Wiley India Pvt. Ltd., 2012.
- Aderson and Ford, "Power System Control and Stability", Wiley India Pvt. Ltd. Second Edition, 2008.
- 6. P. S. Bimbhra, "The Generalised Theory of Electrical Machines", Khanna Publishers, 6th Edition, 2011.
- 7. Peter W. Sauer and M A Pai, Joe H. Chow "Power System Dynamics and Stability", Wiley-IEEE Press, Second Edition, 2017.
- 8. http://nptel.iitm.ac.in

P	ower Elec	tronics and Distribu	ited Generation	on (Prof	essional Elective C	Course – IV	/)
q	<b>D D</b>		COURSE OU		DEADC	G	[
Course	Power E	lectronics and Distri	ibuted	Short	PE&DG	Course	
	Generati	lon		I itie:		Code:	
Course d	escription	: -:1(:		· · · · · · · ·			11
Introduct:	ion to disti	ribution systems, dist	ribution system	n equipi	nent, grounding, se	equence ana	ilysis and
Taun can	ulations, 1	relaying requirement	s for Distribu	anid into	recation (DG) syste	ems. Intent	ional and
	onte Soloe	tion of nover converter	topologies for	$\sum_{n=1}^{\infty} DC hn$	connection, inverte	et modeling	, mering
and relial	bility in th	e design procedure	thermal cyclin	s, DC bu	wer semiconductor	modules	insulation
orade se	lection ar	nd thermal design i	mplications (	ontrol	of grid interactive	nower c	onverters
synchron	ization and	l phase locking tech	niques current	control	DC bus control	converter fa	aults orid
parallel a	nd standal	one operation Powe	r quality volt	age unb	alance harmonics	flicker vo	ltage and
frequency	windows.	and recent trends in	power electror	nic DG in	nterconnection.	incher, vo	nuge una
Lecture		Hours/week	No. of wee	ks	Total hours	Semeste	r credits
		03	14		42	0	3
Prereaui	Prerequisite course(s):						
Electric P	ower Syst	em. Power Electronic	s and Power S	vstem P	rotection		
Course o	biectives:			<i>J</i> ~ ~ ~ ~ ~ ~ ~ ~ ~			
1. Intro	oduce the c	oncept of distributed	generation.				
2. Inve	stigate the	technical challenges	of Distributed	Generat	ion interconnection	relaying ar	nd various
pow	er quality i	issues.					
3. Ana	lyze power	converter design for	the Distribute	d Genera	ation.		
4. Ana	lyze the Se	emiconductor device	selection in DC	applica	ations.		
5. Inve	stigate the	various issues relate	d to the protec	tion, po	wer quality, insulat	tion ageing	and filter
desi	gns for DC	j.					
Course o	utcomes:						
After suc	cessful cor	npletion of this cours	e the student w	ill be at	ole to:		
1. Exp	lain the ba	sics of distributed ger	neration.				
2. Analyze the use of different network distribution grids and impact of DG operation							
3. Exp Con	lain the use trol.	e of Intentional and u	nintentional isl	anding s	systems for DG, the	eir technolog	gies and
4. Interpret the performance analysis and life time estimation of power converters for DG.							
5. Disc	harge prof	essional duties in pov	wer industry w	ith innov	vative ideas of operative	ation and co	ontrol of
distr	ibuted gen	eration.			1		
		(	COURSE CO	NTENT			

COURSE	CONTENT	
Power Electronics and Distributed Generation	Semester:	VII

<b>Teaching Scheme:</b>			Examination scheme			
Lectures:	3 hours	s/week	End Semester H	60 marks		
			Duration of ES	Е:	03 hours	
			Internal Session	nal Exams (ISE):	40 marks	
Unit–I:		No. of Lectu	res: 09 Hours	Marks: 1	2	
Distributed Generation (	DG) - O	verview and tech	nology trends. In	troduction to distributi	ion systems.	
Radial distribution system	n protect	ion: Fuse, circuit	breakers, recloser	rs, sectionalizers. Per-u	init analysis,	
fault analysis, sequence	compon	ent analysis, seq	uence models of	distribution system of	components.	
Implications of DG on di	stributio	n system protectio	on coordination.			
		-				
Unit–II:		No. of Lectu	res: 08 Hours	Marks: 1	2	
Power quality requirement	nts and s	ource switching u	ising SCR based s	tatic switches. Distribu	ation system	
loading, line drop model,	series vo	ltage regulators a	nd on line tap chai	ngers. Loop and second	lary network	
distribution grids and i	mpact c	of DG operation	. Relaying and	protection, distributed	generation	
interconnection relaying,	sensing		S.			
 ∐nit_III∙		No of Lectu	res: 08 Hours	Marks: 1	2	
Intentional and unintent	tional is	landing of distri	ibution systems	Passive and active of	detection of	
unintentional islands, no	n detecti	on zones. DG r	planning cost imp	lications of power qua	lity, cost of	
energy and net present va	alue calcu	ulations and impl	ications on power	converter design. Pow	er converter	
topologies and model and	l specific	ations for DG ap	plications.	6		
	•					
Unit–IV:		No. of Lectu	res: 08 Hours	Marks: 1	2	
Capacitor selection, choice	ce of DC	bus voltage, cur	rent ripple, capaci	tor aging and lifetime	calculations.	
Switching versus average	e model	of the power con	nverter and EMI of	considerations in DG a	applications.	
Semiconductor device se	lection, c	levice aging due t	to thermal cycling	, and lifetime calculation	ons.	
				1		
Unit–V:		No. of Lectu	res: 09 Hours	Marks: 1	2	
Issues in output ac filter of	lesign, fi	lter inductor selec	ction. Insulation ag	ging issues. Packaging	issues in the	
power converter. Calcula	tion of d	amage due to the	rmal cycles. Theri	nal impedance models	. Control of	
DG inverters; phase locke	ed loops,	current control ar	nd DC voltage con	trol for standalone and	grid parallel	
operations. Protection of	t the coi	nverter. Complex	transfer function	ns, VSI admittance m	odel in DG	
applications. Power qual	ity impli Lootivo fi	itation, acceptabl	e ranges of voltage	ge and frequency, file	ker, reactive	
power compensation, and active intering and low voltage ride through requirements.						
Tavt Books:						
1 Math H. I. Bollen and Fainan Hassan "Integration of Distributed Concration in the Dower						
System" Wiley 2018						
	,10.					
Reference Books:						
1. Arthur R. Bergen,	Vijay Vi	ttal, "Power Syst	ems Analysis", Pe	earson Education India	, 2 nd edition.	
2009.	5.5	, J	, , , , , , , , , , , , , , , , , , ,		,,	
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2. Ned Mohan, Tore M. Undeland, William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, Third Edition, 2014.

	In	dustrial Elect	trical Sy	ystems (P	rofessiona	l Electiv	e Course -	- IV)	
COURSE OUTLINE									
Course	Industria	al Electrical s	ystems			Short	IES	Course	
Title:						Title:		Code:	
Course d	escription	:							
The subje	ect explore	es the knowled	dge of I	Electrical	System C	omponer	its, Reside	ntial and C	Commercial
Electrical	Systems,	Illumination	System	is, Industr	ial Electr	ical Syst	ems: HT	connection	, Industrial
Electrical	System A	utomation. Red	cognize	the need f	or technic	al change	& ability	to learn in f	he broadest
knowledg	e of Techr	ncal Advancer	ment in	Electrical	System, I	lluminatio	on and othe	er Applicat	ions.
Lecture		Hours/we	ek	No. of	weeks	Tota	al hours	Semes	ter credits
		03		1	4		42		03
Prerequi	site course	e(s):							
Electrical	Machines	and mathemat	tics						
Course o	bjectives:								
To provid	le in-dept	h understandi	ng of E	Electrical	System Co	omponen	ts, Reside	ntial and <b>(</b>	Commercial
Electrical	Systems,	Industrial Ele	ectrical	Systems:	HT conne	ection, in	dustrial su	Ibstation, 7	Transformer
selection,	Role of E	ngineer in auto	omation	, advantag	ges of proc	ess auton	nation		
Course o	utcomes:								
After suce	cessful con	npletion of this	s course	e the stude	nt will be	able to:			
1. Und	erstand the	e electrical wi	iring sy	stems for	residentia	ıl, comm	ercial and	industrial	consumers,
repro	esenting th	e systems with	n standa	rd symbol	s and drav	vings, SL	D.		
2. Und	erstand va	rious terms re	egarding	g light, lui	men, inten	sity, can	dle power,	lamp effi	ciency, and
spec	ific consur	nption.					<b>.</b> .		G 1
3. Und	erstand va	rious compor	nents of	i industria	al electrica	al system	ns, Industr	hal loads,	Switchgear
selec	ction 1	11							
4. Ana	lyze and se	elect the proper	r size of	Transfor	mer.	. 1			
5. Und	erstand Ro	le of in autom	ation, P	LC based	control sy	stem desi	ign, Panel	Metering	
				OUDSE	CONTEN	T			
Industria	Flootrio	alevetome	t	UUKSE	Somosto	1	V	п	
Traching		ai systems			F		•	11	
Teaching	Scheme:		/ 1		Examina	tion sch	eme		<u>()</u>
Lectures		3 hours	s/week		End Sen	nester Ex	am (ESE)	:	60 marks
	Duration of ESE: 03 hours						03 hours		
Internal Sessional Exams (ISE):40 marks									
	Unit–I: No. of Lectures: 09 Hours Marks: 12								
Electrica	Electrical System Components: LT system wiring components, selection of cables, wires, switches,								
distributio	distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB,								

inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12							
Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems,									
general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch,									
distribution board and protection devices, earthing system calculations, requirements of commercial									
installation, deciding lighting sc	heme and number of lamps, ear	thing of commercial installation,							
selection and sizing of component	selection and sizing of components.								
Unit-III:	No. of Lectures: 08 Hours	Marks: 12							
Illumination Systems: Understan	nding various terms regarding ligh	t, lumen, intensity, candle power,							
lamp efficiency, specific consump	tion, glare, space to height ratio, wa	ste light factor, depreciation factor,							
various illumination schemes, Ind	candescent lamps and modern lun	ninaries like CFL, LED and their							
operation, energy saving in illun	nination systems, design of a light	ting scheme for a residential and							
commercial premises, flood lighting	ng.	2							
Unit-IV:	No. of Lectures: 09 Hours	Marks: 12							
Industrial Electrical Systems: H	T connection, industrial substation	, Transformer selection, Industrial							
loads, motors, starting of motors,	SLD, Cable and Switchgear selecti	on, Lightning Protection, Earthing							
design, Power factor correction –	kVAR calculations, type of compen	sation, Introduction to PCC, MCC							
panels. Specifications of LT Breal	kers, MCB and other LT panel com	ponents.							
Unit–V:	No. of Lectures: 08 Hours	Marks: 12							
Industrial Electrical System Au	tomation: Study of basic PLC, Ro	le of in automation, advantages of							
process automation, PLC based of	control system design, Panel Mete	ring and Introduction to SCADA							
system for distribution automatior	1								
Text Books:									
1. S. L. Uppal, G. C. Garg, "Ele	ectrical Wiring, Estimating & costir	ng", Khanna publishers, 6 th							
edition, 2008.									
Reference Books:									
1. K. B. Raina, "Electrical Desi	gn, Estimating & Costing", New ag	ge International, 1 st edition, 2007.							
2. S. Singh, R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 2 nd edition, 2010.									
3. J. B. Gupta, "Utilization of E	Electric Power & Electric Traction"	, S.K. Kataria & Sons, 2 nd edition,							
2014.									
4. H. Joshi, "Residential Comm	ercial and Industrial Systems", Vol	ume I, McGraw Hill Education,							
2008.	-								

COURSE OUTLINE         Course Title:       Power System Design Practice       Short Title:       PSD P Code:       Course Code:         This course deals with design aspects of transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.         Lecture       Hours/week       No. of weeks       Total hours       Semester credits         7       Power System I, Power System II       3       12       42       3         Prerequisite course(s):         Course objectives:         1       To ducate students about the process of restructuring of power system         2. To familiarize students about the operation of power system         2. To familiarize students about the operation of power system         2. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Course outomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems.       .       .       .         3. Model the distribution systems and design		Power System Design Practice (Professional Elective Course – IV)									
COURSE OUTLINE         Course       Power System Design Practice       Nort       PSDP       Course         Title:       Code:       Code: <td< td=""><td colspan="10"></td></td<>											
Course Title:       Power System Design Practice       Short Title:       PSDP       Course Code:         Title:       Title:       Code:       Code:         This course description:       Title:       Code:       Code:         This course description:       Total membra along with their testing. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.       Semester credits         Tercequistic course(s):       Hours/week       No. of weeks       Total hours       Semester credits         Power System I, Power System II       Power System II       Semester credits       3         Course objectives:       In oradinatize shout the process of restructuring of power system       Semester credits         1. To educate students about the process of restructuring of power system.       Semester credits       Semester credits         3. To teach students about designing concepts       In analyze the terms required for tender filling.       Semester credits       Semester credits         After successful completion of this course the student will be able to:       In Analyze the aspects of designing various electrical systems.       Intervention system.       Intervention system.         3. Identify different abnormal conditions and design it.       Semester:       VII       Intervention s		COURSE OUTLINE									
Title:       Title:       Code:         Course description:       Code:       Code:         This course deals with design aspects of transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.         Lecture       Hours/week       No. of weeks       Total hours       Semester credits         Prerequisite course(s):       3       12       42       3         Prerequisite course(s):       Prerequisite course(s):       Semester credits       3         1. To educate students about the process of restructuring of power system       2. To familiarize students about the operation of power system       3. To teach students about designing concepts         3. To teach students about designing concepts	Course	Power Sy	stem Design Practice	9	Short	PSDP	Course				
Course deals with design aspects of transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.         Vertex in the course sets high standards in corporate sector as it deals with on field concepts of power system.         Semester credits         Vertex in the course sets high standards in corporate sector as it deals with on field concepts of power system.         Vertex in the course system is it deals with on field concepts of power system I.         Vertex in the course system is about the process of restructuring of power system.         Course objectives:         1. To educate students about the process of restructuring of power system.       3       1       4       2       3         2. To familiarize students about the process of restructuring of power system.       3       1       4       5       5       5       1       6       1       1       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6       6 <td< td=""><td>Title:</td><td colspan="10">Title:   Code:</td></td<>	Title:	Title:   Code:									
This course deals with design aspects of transmission and Distribution sector. Electric power systems including power flow analysis. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.           Lecture         Hours/week         No. of weeks         Total hours         Semester credits           Prerequisite course(s):         3         12         42         3           Power System I, Power System IF         Semester credits         3         3         3           Course objectives:         Prerequisite course(s):         Semester credits         3           1         To deducate students about the process of restructuring of power system         2         7           3         To teach students about de operation of power system         3         1         2           4         To gain knowledge of fundamental concept of protection devices.         5         5         7         5         7           After successful completion of this course the student will be able to:         1         1         Analyze the aspects of designing various electrical systems         3         1         1         1         42         3           2         Model the distribution systems with complex technical constraints.         3         1         1         1	Course d	Course description:									
including power flow analysis. The course has abundant information about tender filling requirements of various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.	This cou	rse deals v	with design aspects o	f transmission and l	Distributi	on sector.	Electric po	wer systems			
various equipments along with their testing. The course sets high standards in corporate sector as it deals with on field concepts of power system.           Lecture         Hours/week         No. of weeks         Total hours         Semester credits           3         12         42         3           Prerequisite course(s):           Power System I           Course objectives:           I To educate students about the operation of power system           3. To teach students about the operation of power system           3. To teach students about designing concepts           4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.           Course outcomes:           Semester versive           After successful completion of this course the student will be able to:           1. Analyze the aspects of designing various electrical systems         .           2. Model the distribution systems with complex technical constraints.         .           3. Identify different abnormal conditions and design protection system.         .           File the tenders for several power system sectors.           Semester crawing Schweizer           QUIT Sectore System Design Practices           Semester crawing Schweizer	including	including power flow analysis. The course has abundant information about tender filling requirements of									
On field concepts of power system.         No. of weeks         Total hours         Semester credits           Lecture         Hours/week         No. of weeks         Total hours         Semester credits           Prerequisite course(s):         3         12         42         3           Power System I, Power System II         Course objectives:         42         3           1. To educate students about the process of restructuring of power system         5         5         5         7         6         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7         7	various e	quipments a	along with their testing	g. The course sets high	n standaro	ds in corpora	ate sector as	s it deals with			
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LectureHours/weekNo. of weeksTotal hoursSemester credits312423Prerequisite course(s):Power System I, Power System IICourse objectives:Course objectives:I. To educate students about the process of restructuring of power system3. To teach students about the operation of power system3. To teach students about designing concepts4. To gain knowledge of fundamental concept of protection devices.5. To analyze the terms required for tender filing.Course outcomes:After successful completion of this course the student will be able to:1. Analyze the aspects of designing various electrical systems2. Course outcomes:Semester Solutions and design protection system.A file the tenders for several power system sectors.S. Classify different abour systems and design it.Semester COURSE CONTENTPower System Design PracticesSemester exam (ESE):60 marksSemester exam (ESE):Semester exam (ESE):OURSE CONTENTExamination schemeLectures:3 hours/weekEnd semister exam (ESE):OURSI' Mitteres:Semester:OURSE:OURSI' Mitteres:			1								
312423Prerequisite course(s):Power System I, Power System IICourse objectives:1. To educate students about the process of restructuring of power system2. To familiarize students about the operation of power system3. To teach students about the operation of protection devices.5. To gain knowledge of fundamental concept of protection devices.5. To analyze the terms required for tender filing.Course outcomes:After successful completion of this course the student will be able to:1. Analyze the aspects of designing various electrical systems2. Model the distribution systems with complex technical constraints.3. Identify different abnormal conditions and design protection system.4. File the tenders for several power system sectors.5. Classify different Earthing systems and design itCOURSE CONTENTPower System Design PracticesSemester:VIITeaching Scheme:Examination scheme:Internal Sessional Exams (ISE):40 marks: 12Design of Transmission System:	Lec	ture	Hours/week	No. of weeks	Tota	al hours	Semes	ter credits			
Prerequisite course(s):       Power System I, Power System II         Course objectives:       Power System I about the process of restructuring of power system         1. To educate students about the operation of power system       Power System I about the operation of power system         3. To teach students about the operation of power system       Power System I about the operation of power system         3. To teach students about designing concepts       Power System I about designing concepts         4. To gain knowledge of fundamental concept of protection devices.       Power System Section devices.         5. To analyze the terms required for tender filing:       Power Systems         After successful completion of this course the student will be able to:       Power System Section systems with complex technical constraints.         3. Identify different about mere systems set of designing various electrical systems.       Power System Design Preveral power system sectors.         5. Classify different about mere systems and design protection system.       Power System Design Preveral power system sectors.         6. Classify different protection system sectors.       Semester:       Power System Course:         7. Course System Design Preveres       Semester:       Power System Sectors:         9. Classify different systems and design Preveres       Power System Sectors:       Power System Sectors:         9. Classify different systems and design Preveres       Power System Sectors: <td></td> <td></td> <td>3</td> <td>12</td> <td></td> <td>42</td> <td></td> <td>3</td>			3	12		42		3			
Power System I, Power System I         Course objectives:         1. To educate students about the process of restructuring of power system         2. To familiarize students about the operation of power system         3. To teach students about designing concepts         4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Course outcomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abour mal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         COURSE CONTENT         Power System Design Practices         Semester:       VII         Teaching Scheme:         Lectures:       3 hours/week       End semester exam (ESE):       60 marks         Internal Sessional Exams (ISE):       40 marks:       2         Identifierer:       No. of Lectures: 09 Hours       40 marks: 12	Prerequi	site course	e(s):								
Course objectives:         1. To educate students about the process of restructuring of power system         2. To familiarize students about the operation of power system         3. To teach students about designing concepts         4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Vertex successful completion of this course the student will be able to:         After successful completion of this course the student systems         After successful completion of this course the student all conception system.         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abover mal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         VECOURSE CONTENT         Power System Design Protection Scheme:         VECOURSE Context         Vectors context         Vectors context         Vectors context         Vectors context         Vectors context         Vectors context         Vecourse:       Vectors context	Power Sy	rstem I, Pov	wer System II								
1. To educate students about the process of restructuring of power system         2. To familiarize students about designing concepts         3. To teach students about designing concepts         4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Course outcomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different atring systems and design it         VII         Teaching Scheme:         Lectures:         2 shours/week       End semester exam (ESE):       60 marks         Lectures:       3 hours/week       End semster exam (ESE):       60 marks         Direction of ESE:       03 hours         Totaction of ESE:       40 marks:	Course o	bjectives:									
2. To familiarize students about the operation of power system         3. To teach students about designing concepts         4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Course outcomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         VII         Teaching Scheme:         Lectures:         3 hours/week       End semester exam (ESE):       60 marks         Lectures:         3 hours/week       End sessional Exams (ISE):       40 marks	1. To e	ducate stud	lents about the process	s of restructuring of p	ower sys	tem					
3. To teach students about designing concepts         4. To gain knowledge of fundamental concept of protection devices.         5. To analyze the terms required for tender filing.         Course outcomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         VOURSE CONTENT         Power System Design Practices         Semester:         VII         Teaching Scheme:         Lectures:         3 hours/week         End semester exam (ESE):         60 marks         O3 hours         Internal Sessional Exams (ISE):       40 marks:         Design of Transmission System:	2. To f	amiliarize s	students about the ope	ration of power syste	em						
<ul> <li>4. To gain knowledge of fundamental concept of protection devices.</li> <li>5. To analyze the terms required for tender filing.</li> <li>5. To analyze the terms required for tender filing.</li> <li>Course outcomes:</li> <li>After successful completion of this course the student will be able to:</li> <li>1. Analyze the aspects of designing various electrical systems</li> <li>2. Model the distribution systems with complex technical constraints.</li> <li>3. Identify different abnormal conditions and design protection system.</li> <li>4. File the tenders for several power system sectors.</li> <li>5. Classify different Earthing systems and design it.</li> <li>Fower System Design Practices</li> <li>Semester:</li> <li>VII</li> <li>Teaching Scheme:</li> <li>2. Bandarding Scheme:</li> <li>2. Bandarding Scheme:</li> <li>3. Bours/week</li> <li>End semester exam (ESE):</li> <li>60 marks</li> <li>03 hours</li> <li>Internal Sessional Exams (ISE):</li> <li>40 marks</li> <li>Design of Transmission System:</li> </ul>	3. To t	each studer	nts about designing co	oncepts							
5. To analyze the terms required for tender filing.  Course outcomes:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student will be able to:  After successful completion of this course the student action system.  A File the tenders for several power systems and design protection system.  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for several power systems and design the sectors:  A File the tenders for sev	4. To g	ain knowle	edge of fundamental co	oncept of protection d	levices.						
Course outcomes:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earbing systems and design it.         COURSE CONTENT         Power System Design Practices         Semester:         VII         Teaching Scheme:         Lectures:         3 hours/week         End semester exam (ESE):         60 marks         Duration of ESE:         03 hours         Internal Sessional Exams (ISE):         Q3 hours         Duration of ESE:         Q3 hours         Internal Sessional Exams (ISE):         Q3 hours         Internal Sessional Exams (ISE):         Q3 hours         Internal Sessional Exams (ISE):         Q3 hours:	5. To a	nalyze the	terms required for ten	der filing.							
Course outcomes:         After successful completion of this course the student will be able to:         After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         FOURSE CONTENT         Power System Design Practices         Semester:         Power System Design Practices         Semester exam (ESE):         Gouration of ESE:         Of a hours/week         End semester exam (ESE):         Quartion of ESE:         Quartion of Lectures: 09 Hours											
After successful completion of this course the student will be able to:         1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         Vertication of this course technical constraints.         Semester:         VII         Vertication of this course the student will be able to:         OURSE CONTENT         Power System Design Practices         Semester:         VII         Teaching Scheme:         Lectures:         A hours/week         End semester exam (ESE):         Outation of ESE:         Outation of Lectures: 09 Hours         Marks: 12	Course o	utcomes:									
1. Analyze the aspects of designing various electrical systems         2. Model the distribution systems with complex technical constraints.         3. Identify different abnormal conditions and design protection system.         4. File the tenders for several power system sectors.         5. Classify different Earthing systems and design it.         VII         OURSE CONTENT         Power System Design Protections System.         VII         Teaching Scheme:         Lectures:         3 hours/week       End semester exam (ESE):       60 marks         Lectures:         3 hours/week       End semester exam (ESE):       40 marks         Duration of ESE:       93 hours         Internal Sessional Exams (ISE):         Quite:	After suc	cessful con	npletion of this course	the student will be at	ole to:						
<ul> <li>2. Model the distribution systems with complex technical constraints.</li> <li>3. Identify different abnormal conditions and design protection system.</li> <li>4. File the tenders for several power system sectors.</li> <li>5. Classify different Earthing systems and design it.</li> </ul> <b>COURSE CONTENT COURSE CONTENT VII COURSE CONTENT OWER System Design Practices Semester:</b> VII <b>Teaching Scheme: Lectures:</b> 3 hours/week       End semester exam (ESE):       60 marks <b>OUration of ESE:</b> 03 hours         Internal Sessional Exams (ISE):       40 marks: <b>Design of Transmission System:</b>	1. Ana	lyze the asp	pects of designing vari	ous electrical system	S						
<ul> <li>3. Identify different abnormal conditions and design protection system.</li> <li>4. File the tenders for several power system sectors.</li> <li>5. Classify different Earthing systems and design it.</li> </ul> Fower System Design Practices COURSE CONTENT Power System Design Practices Semester: VII Teaching Scheme: Lectures: 3 hours/week End semester exam (ESE): 60 marks Internal Sessional Exam; (ISE): 03 hours Internal Sessional Exam; (ISE): VII Design of Transmission System:	2. Mod	lel the distr	ibution systems with c	complex technical con	nstraints.						
<ul> <li>4. File the tenders for several power system sectors.</li> <li>5. Classify different Earthing systems and design it.</li> <li>5. Classify different Earthing systems and design it.</li> <li>COURSE CONTENT</li> <li>Power System Design Pretices</li> <li>Semester:</li> <li>VII</li> <li>Teaching Scheme:</li> <li>Examination scheme</li> <li>End semester exam (ESE):</li> <li>60 marks</li> <li>Lectures:</li> <li>A hours/week</li> <li>End semester exam (ESE):</li> <li>60 marks</li> <li>Internal Sessional Exam:</li> <li>VII</li> <li>VII</li> </ul>	3. Iden	tify differe	nt abnormal condition	s and design protection	on systen	1.					
5. Classify different Earthing systems and design it.         COURSE CONTENT         COURSE CONTENT         Power System Design Practices       Semester:       VII         Teaching Scheme:       Examination scheme       60 marks         Lectures:       3 hours/week       End semester exam (ESE):       60 marks         Duration of ESE:       03 hours         Internal Sessional Exams (ISE):       40 marks         Design of Transmission System:       No. of Lectures: 09 H∪rs       Marks: 12	4. File	the tenders	for several power sys	tem sectors.							
COURSE CONTENT         Power System Design Practices       Semester:       VII         Teaching Scheme:       Examination scheme         Lectures:       3 hours/week       End semester exam (ESE):       60 marks         Lectures:       3 hours/week       Internal Sessional Exam; (ISE):       40 marks         Unit–I:       No. of Lectures: 09 Hours       Marks: 12         Design of Transmission:	5. Clas	sify differe	ent Earthing systems a	nd design it.							
COURSE CONTENTPower System Design PracticesSemester:VIITeaching Scheme:Examination schemeLectures:3 hours/weekEnd semester exam (ESE):60 marksLectures:3 hours/weekDuration of ESE:03 hoursInternal Sessional Exams (ISE):40 marksUnit–I:No. of Lectures: 09 HoursMarks: 12Design of Transmission System:Unit-I:Unit-I:											
Power System Design Practices     Semester:     VII       Teaching Scheme:     Examination scheme       Lectures:     3 hours/week     End semester exam (ESE):     60 marks       Duration of ESE:     03 hours       Internal Sessional Exams (ISE):     40 marks       Unit–I:     No. of Lectures: 09 Hours     Marks: 12       Design of Transmission System:     50 marks     50 marks				COURSE CONTEN	T						
Teaching Scheme:       Examination scheme         Lectures:       3 hours/week       End semester exam (ESE):       60 marks         Duration of ESE:       03 hours         Internal Sessional Exams (ISE):       40 marks         Unit–I:       No. of Lectures: 09 Hours       Marks: 12         Design of Transmission System:       Value       Value	Power Sy	ystem Desi	gn Practices	Semester	•	VI	Ι				
Lectures:       3 hours/week       End semester exam (ESE):       60 marks         Duration of ESE:       03 hours         Internal Sessional Exams (ISE):       40 marks         Unit–I:       No. of Lectures: 09 Hours       Marks: 12         Design of Transmission System:       50 marks       50 marks	Teaching	g Scheme:		Examina	tion scho	eme					
Duration of ESE:03 hoursInternal Sessional Exams (ISE):40 marksUnit–I:No. of Lectures: 09 HoursMarks: 12Design of Transmission System:	Lectures	:	3 hours/week	End sem	ester exa	m (ESE):		60 marks			
Internal Sessional Exams (ISE):40 marksUnit–I:No. of Lectures: 09 HoursMarks: 12Design of Transmission System:		Duration of ESE: 03 hours						03 hours			
Unit–I:No. of Lectures: 09 HoursMarks: 12Design of Transmission System:		Internal Sessional Exams (ISE): 40 marks									
Design of Transmission System:		Unit–I: No. of Lectures: 09 Hours Marks: 12									
	Design of	f Transmis	ssion System:								

Selection of insulation parameters, selection of volta	ge level, choice of type of conduct	or, Design aspects of							
Transmission systems( GMD and GMR), Characteristic impedance and its significance, Radio interference									
and transposition.									
Mechanical design of transmission line, Sag, Tension, wind effect and ice loading.									
Unit–II:	No. of Lectures: 09 Hours	Marks: 12							
Design of Distribution System:									
Types of distribution system arrangements, Prima	ry and secondary distribution de	esign, calculation of							
distribution sizes: voltage drops, efficiency, voltage	e regulation, types of cables used,	, design of rural and							
industrial distribution systems.									
Unit–III:	No. of Lectures: 08 Hours	Marks: 12							
Design of Protection Systems:									
Operating mechanism, ratings and specifications, typ	es of circuit breakers.								
Operating mechanism, ratings and specifications, typ	es of Lightning Arrestors.								
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12							
Tenders Filing in Power System:									
Special characteristics to be defined in tender filing	of Circuit Breakers, Lightning Arr	estors, Transformers,							
Cables, Shunt Capacitors.									
Testing of Circuit Breakers, Lightning Arrestors, Shu	int Capacitors.								
Unit–V:	No. of Lectures: 08 Hours	Marks: 12							
Earthing Systems:									
Need of Earthing, various ways of Earthing accordin	g to voltage levels.								
Different Earthing done for transmission and distribu	tion lines.								
Earthing Systems- step potential, touch potential, trai	nsfer potential.								
Text Books:									
1. M. V, Deshpande, "Restructured E;lectrical Po	wer System Design", Tata McGrav	w Hıll, 2014.							
2. B. R. Gupta, "Power System Analysis and Des	ign" S Chand & Company, 2005.								
Reference Books:									
1. Pratapsing Satnam, P. V. Gupta, "Substation Design Equipments" Dhanpat Rai and Sons									
2. K. B Raina and S. K. Bhattacharya, "Electrical	Design-Estimation and Costing",	New age							
international publishers, 2007.									

	VLSI Design and Technology (Open Elective Course – III)							
COUDSE OUT INF								
Course	VLSI De	sign and Technolog	V	E Short	VLSIDT	Course	1	
Title:	120121		J	Title:	120121	Code:		
Course d	escription	1:					- 1	
This cour	rse provid	es the basic knowle	dge necessary to un	nderstand	how to sin	nulate syst	ems using	
hardware	description	on languages. System	here includes varie	ous digit	al logic circ	uits, such	as adders,	
multiplex	ers, flip-fl	ops, counters etc. VH	DL is a hardware des	cription l	anguage that	can be use	d to model	
a digital s	system. It c	contains elements that	t can be used to desc	ribe the b	ehavior or s	tructure of	the digital	
system. I	he langua	ge provides support	for modeling the sys	stem hier	archically ar	nd also sup	ports top-	
down and	bottom-u	p design methodolog:	les.	Tat	hound	Someet	an anadita	
Lecture				100		Semest		
Duono qui	cito comma		14		42		J <b>S</b>	
Frerequi	site cours							
Course o	hiectives							
VLSI De	sign provi	ides fundamental co	ncepts in classical n	nanual d	igital design	design e	ntry using	
hardware	descriptio	on language. It emph	asizes the HDL-bas	ed design	because it	is the mos	st efficient	
design me	ethod to us	se in practice. This su	bject describes in de	tails the I	EEE Standar	rd VHDL I	anguage.	
		-	-					
Course o	utcomes:							
After suc	cessful con	npletion of this cours	e the student will be	able to:				
1. Unde	rstand the	modeling and design	concepts of digital sy	vstems do	mains for dif	fferent con	ibinational	
and s	equential c	circuits. Also understa	and the concepts of data	ata-flow	description in	n VHDL. I	dentify the	
signa	l assignme	ent statement. Recogn	ize the levels of mod	leling usi	ng VHDL.			
2. Unde	rstand the	concepts sequential	statements and how	v differ	from concur	rent stater	nent. Also	
1denti 2 Undo	retand the	ac statement of benav	loral description.	ng tha hi	nding of mo	dulas.		
J. Unde	rstand the	concepts of structura	and simulating digi	ng the Di	nullig of filoc	ules.	so identify	
the h	asic statem	ents of switch-level t	ackage that matches	the swit	ch-level fund	sistors. Ai	so identify	
5. Unde	rstand the	function of simulato	r. synthesizer and Pl	Ds. Als	o the concer	ots of state	s and their	
imple	implementation.							
1								
	COURSE CONTENT							
VLSI Design and TechnologySemester:VII								
Teaching Scheme: Examination scheme								
Lectures	:	3 hours/week	End Sen	nester Ex	am (ESE):		60 marks	
	Duration of ESE: 03 hours					03 hours		
L			I					

	Internal Session	nal Exams (ISE):	40 marks				
Unit–I:	No. of Lectures: 09 Hours	Marks: 12	2				
<b>Introduction:</b> History of HDL: Brief history of VHDL. Structure of VHDL module: Structure of Entity/ Module, Port. Operators in VHDL: Logical, Relational, Arithmetic Shift and Rotate Operators. Data types of VHDL. Types of Architectures. Simulation and Synthesis and comparison between them.							
assignment statements, Concurrent Signal assignment statements, Constant declaration and assignment statements, Assigning a delay to the signal assignment statements, VHDL Programming using Data-flow							
description.							
Unit–II:	No. of Lectures: 08 Hours	Marks: 12	2				
Behavioral Description (VHDL)	: Structure of Behavioral Description	on for both VHDL. VH	DL variable				
assignment statement. Sequential VHDL) assignment, Case statemen Procedures and Functions (VHDL	statements for VHDL: IF statem nt, Loop statement. VHDL Program .).	ent, Signal and variab ming using Behavioral	le (only for description.				
Unit–III:	No. of Lectures: 08 Hours	Marks: 12	2				
Structural Description (VHDL)	: Organization of structural design,	, Binding, State machir	nes, Generic				
(VHDL), VHDL Programming us	ing Structural description.	-					
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12	2				
Switch-Level Description (VHD description for VHDL, Serial an Primitive gates, Combinational log Type description.	<b>DL):</b> Single NMOS and PMOS swind parallel combinations of switc gics, Sequential circuits. CMOS swi	vitches: NMOS and PM whes. Switch level des tch. Bidirectional switc	MOS switch cription of: hes. Mixed-				
Lin:4 V.	No. of Lootunest 00 Houng	Montres 1	,				
	No. of Lectures: 09 Hours		2				
<ul> <li>Finite state machine: Moore machine, Mealy machine, State diagram, State table, State Assignment.</li> <li>Programmable Logic Devices: Architectures of Xilinx 9500 series CPLD, Xilinx Spartan 4000 series FPGA.</li> <li>Testing of Logic Circuits: Fault model, path sensitizing, random test. Design of testability, BIST (Built-in-self-test), Boundary scan test.</li> </ul>							
Text Books:							
<ol> <li>Nazeib M. Botros, "HDL programming Fundamentals VHDL and Verilog", Second Indian Edition, DA Vinci Engineering Press, Hingham, Massachusetts, 2011.</li> <li>Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with VHDL design", McGraw Hill Education (India) Private Limited, New Delhi, Third Edition, 2012.</li> <li>J. Bhaskar, "A VHDL Primer", Pearson, Third Edition, 2006.</li> </ol>							
Keterence Books:1. John F. Wakerly, "Digital De 2007.	esign, Principles and Practices", Po	entice Hall Publication,	4 th edition,				

- 2. Douglas L. Perry, "VHDL: Programing by example", Tata MC-Graw Hill, New Delhi, Fourth Edition, 2005.
- 3. Volnei A. Pedroni, "Circuit Design with VHDL", Prentice-Hall of India Private Limited, New Delhi, 2nd edition, 2011.
- 4. Xilinx data manual, The Programmable Logic data Book.

	Artificial Intelligence (Open Elective Course – III)									
Course	Artificial	Intelligence				Short	AI	Course	9	
Title:	Title:   Code:									
Course d	escription:									
It is to in	It is to introduce the students to the fundamentals of Artificial Intelligence, NLP and Neural Networks									
and enabl	and enable them to apply these concepts for solving real world problems.									
Lecture		Hours/we	eek	No. of	weeks	Tota	al hours	s Semes	ster credits	
		03		1	4		42		03	
Prerequi	site course(	s):								
Course o	bjectives:									
1. To	understand .	AI Problem a	and AI Te	chnique	s.					
2. To	learn heuris	tic search tec	hniques in	n AI						
3. To	learn variou	s ways to rep	present kn	owledge	e in AI					
4. To	understand j	planning and	game pla	ying str	ategies in A	4I				
5. To	understand l	basics of Net	ural Netwo	orks						
Course o	utcomes:									
After suc	cessful com	pletion of this	s course tl	he stude	nt will be a	able to:				
1. Ap	ply AI techn	iques to solv	ve differen	t AI pro	blems.					
2. Ap	ply appropri	ate search al	gorithms t	to solve	AI probler	ns.				
3. Use	e different k	nowledge rep	presentatio	onal stra	tegies to re	epresent	an AI pi	oblem.		
4. Ap	ply appropri	ate algorithm	n for game	e playing	g.					
5. Un	derstand the	role of neura	al network	ks in AI.						
			CO	URSE	CONTEN	Т				
Artificial	Intelligenc	e			Semester	:		VII		
Teaching	Scheme:				Examina	tion Sch	neme:			
Lectures	•	3 hours	s/week		End Sem	ester Ex	am (ES	SE):	60 marks	
					Duration	of ESE	:		03 hours	
					Internal	Sessiona	al Exam	(ISE):	40 marks	
	Unit_I		No. o	f Lectu	res: 09 Ho	urs		Marks: 1	2	
Introduc	Introduction to Artificial Intelligence.									
Definitions of Artificial Intelligence, AI Problems, AI Techniques										
Defining Problem as a State Space Search: 8 Queens Problem / 8 Puzzle Problem and its solution using										
production system, Water Jug problem and its solution using production system.										
-	Production System, in die vag prostem and its solution doing production system.									
	Unit-II		No. o	f Lectu	res: 09 Ho	urs		Marks: 1	2	
<u> </u>										

Heuristic Search in AI									
Breadth First Search, Depth First Search									
Best First Search: OR Graph, A* Algorithm									
Problem Reduction: AND-OR Graph, AO* Algorithm									
Unit–III	No. of Lectures: 08 Hours	Marks: 12							
Knowledge Engineering:									
Knowledge Representation Issues									
Knowledge Representation Sche	mes: Logical Knowledge Repres	sentation, Procedural Knowledge							
Representation, Structural Knowle	dge Representation								
Unit–IV	No. of Lectures: 08 Hours	Marks: 12							
Planning and Game Playing:									
Planning, Types of Planning									
Goal Stack Planning: Overview, B	lock World Problem								
Game Playing: Game Tree, Min M	lax Search Algorithm								
Unit–V	No. of Lectures: 08 Hours	Marks: 12							
Neural Networks:									
Biological Neural Network, Artif	icial Neural Network, Difference	between Biological and Artificial							
Neural Network, Types of Artifi	cial Neural Network, Models of	Neuron: McCulloch-Pitts Model,							
Perceptron, Adeline Topology									
Text Books:									
1. Elaine Rich, Kevin Knight, S	hivshankar Nair "Artificial Intellige	ence". 3 rd Edition, TMH.							
2. B. Yegnanarayana "Artificial	Neural Networks", PHI, 2006.								
Reference Books:									
1. S. Rajasekaran, G.A. Vijayalakshmi, "Neural Networks, Fuzzy Logic, and Genetic Algorithms", PHI 2013									
2. Timothy J Ross, "Fuzzy Logic with Engineering Application", Wiley, 3 rd edition 2010									
3 Dan W Patterson "Introducti	ion to artificial intelligence and even	vert system" PHI 1 st edition							
3. Dan W. Patterson, "Introduction to artificial intelligence and expert system", PHI, 1 st edition, 2015.									

Virtual Reality (Open Elective Course – III)									
G	177 / 10	1.	COURSE	E OUTLII	NE	T	G		
Course	Virtual Rea	lity			Short	VR	Course		
Title:									
Virtual Pool	Course description:								
artificial env	vironment th	he user is abl	e to explore the	e various a	ne a sinu artifacts ai	nd procee	dings as they	might in the	
real world.	vironnent, ti		e to explore in		intiliaets al	nu procee	ungs as mey	inight in the	
Lecture	I	Hours/week	No. of	weeks	Tota	l hours	Semest	er credits	
		03	14	4		42		03	
Prerequisit	e course(s):								
Course obj	ectives:								
1. To un	derstand Vir	tual Reality	and Virtual en	vironment					
2. To kn	ow Different	tillumination	n models.						
3. To un	derstand Geo	ometric Tran	sformation						
4. To Kr	now about Vi	irtual Hardw	are and Softwa	are					
5. To lea	urn Virtual R	eality applic	ations.						
Course out	comes:								
After succes	ssful complet	tion of this c	ourse the stude	ent will be	able to:				
1. Descr	ibe Virtual R	Reality and V	irtual environi	ment.					
2. Expla	in different il	llumination	models.						
3. Use G	eometric Tra	ansformation	ns for creation	of various	geometri	c objects			
4. Expla	in Virtual Ha	ardware and	Software						
5. Analy	ze Virtual R	eality applic	ations.						
			COURSE	CONTE	NT				
Virtual Rea	ality			Semeste	er:		V	II	
Teaching S	cheme:			Examin	ation Scł	neme:			
Lectures:	Lectures:3 hours/weekEnd Semester Exam (ESE):60 marks					60 marks			
				Duratio	n of ESE	•		03 hours	
Internal Sessional Exam (ISE):40 marks					40 marks				
	Unit–I:		No. of Lectu	res: 09 H	ours		Marks: 12	2	

**Virtual Reality and Virtual Environment:** Introduction, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark, 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection.

Unit–II:No. of Lectures: 09 HoursMarks: 12Simple 3D modeling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden<br/>Surface Removal, Realism-Stereographic image. Geometric Modeling: Introduction, From 2D to 3D, 3D<br/>boundary representation.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12			
Geometrical Transformations:	Introduction, Frames of reference, N	Iodeling transformations, Instances,			
Picking, Flying, Scaling the V	E, Collision detection. Generic	VR system: Introduction, Virtual			
environment, Computer environm	nent, VR technology, VR Systems.				

Unit-IV:No. of Lectures: 08 HoursMarks: 12Animating the Virtual Environment:Introduction, The dynamics of numbers, shape & objectinbetweening, free from deformation, particle system.Physical Simulation:in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12						
VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR								
systems. VR Software: Introdu	ction, Modeling virtual world,	Physical simulation, VR toolkits,						
Introduction to VRML.VR Applications: Introduction, Engineering, Entertainment, Science, Training.								
The Future: Virtual environment,	modes of interaction.							

#### **Text Books:**

1. John Vince, "Virtual Reality Systems", Pearson Education Asia, 2011.

- 1. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
- Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
- 3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann, 2nd edition, 2018.

<b>Bio-Medical Instrumentation (Open Elective Course – III)</b>										
G	D' 14 1'		COURSE OUTLI		DM	G				
Course	Bio-Medica	al Instrumentation		Short	BMI	Course				
Title:				Title:		Code:				
Course d	escription:									
This cou	rse provides	knowledge about	biomedical instru	nents used	in medic	al applicati	on medical			
Lecture		Hours/week	No. of weeks	Tot	al hours	Semes	ter credits			
Leeture		03	14		42		03			
Prereaui	site course(s	):								
Trerequi	site course(s	)•								
Course o	biectives:									
1. To	introduce the	e electrical engineeri	ng students with bi	omedical n	neasureme	nt in patient	monitoring			
sys	tem.									
2. To	understand o	peration of various	electrical transduc	er for medi	ical measu	rement				
3. To	study the pat	ient Monitoring sys	tem and importance	e of Patient	Safety rela	ated with ele	ectric shock			
haz	ards.									
4. To	understand p	rinciple and operation	on of instrument fo	r blood pre	ssure and c	ardiac meas	surement.			
5. To	study the mo	dern imaging syster	n and Electrotherap	y equipme	nt.					
Course o	utcomes:									
After suc	cessful comp	letion of this course	the student will be	able to:						
1. Un	derstand the	importance of biome	edical measuremen	t in patient	monitoring	g system.				
2. Un	derstand the	application of the ele	ectronic systems in	medical ap	plications.					
3. Un	derstand and	able to interpret the	signals like ECG,	EMG and H	EEG.					
4. Un	derstand the	blood pressure meas	urement, causes of	cardiac fai	lure and re	medies for o	cardiac			
fail	ure.									
5. Un	derstand oper	ation and application	ons of modern imag	ing system	and Electr	otherapy eq	uipment in			
me	dical diagnos	is.								
			COURSE CONTE	NT						
Bio-Medical Instrumentation Semester: VII										
Teaching	g Scheme:		Examination	on scheme						
Lectures	: 03	3 hours/week	End Seme	ster Exam	(ESE):		60 marks			
		•	Duration	of ESE:			03 hours			

	Internal Sessional Exams (ISE):40 marks								
Unit–I:	No. of Lectures: 09 Hours	Marks: 1	2						
Bioelectric signals: Brief introduction to human physiology, Biochemical system, Cardiovascular system,									
Respiratory system, Nervous system. Origin of bioelectric Signals ECG, EEG, EMG.									
Electrode Tissue interface, Metal Electrolyte interface, Electrolyte Skin interface, Recording electrode for									
ECG- Floating electrode, Limb electrode. Electrode for EEG, Electrode for EMG.									
Unit–II:	No. of Lectures: 08 Hours	Marks: 12							
Transducers and Biomedical Recorder: Pressure transducer-LVDT, strain gage transducer. Transducer									
for Temperature measurement, Thermocouples, Thermometer, Thermistor. Pulse sensor-Photo Electric									
pulse sensor. Recording Systems-Basic recording system, General consideration for bioelectric recorder									
amplifier, Sources of noise in low level recording system.									
Unit-III:	No. of Lectures: 08 Hours	Marks: 1	2						
Patient Monitoring and Patient S	afety: ECG machine, isolated amplit	fier in ECG machine. El	EG machine,						
EMG machine. Patient monitoring system- Bedside monitor, Patient Safety-Electric shock hazards,									
Leakage currents, Precautions to minimize Electric shock hazards, Types of Leakage currents, Methods to									
reduce Leakage currents. Test instruments for checking safety parameter of biomedical equipment.									
Unit-IV:	No. of Lectures: 09 Hours	Marks: 1	2						
<b>Biomedical Measurement and T</b>	Therapeutic Equipments: Measure	ment of heart rate, A	verage heart						
meter. Instantaneous heart rate meter. Blood pressure measurement-Direct method, Indirect method of									
blood pressure measurement - ko	protkoff' method, Rheographic met	hod. Cardiac pacemak	ers-External						
pacemakers, implantable pacemak	ers, programmable pacemaker. Card	liac defibrillators-DC d	lefibrillators,						
Defibrillator electrode.									
Unit–V:	No. of Lectures: 08 Hours	Marks: 1	2						
Modern imaging system and Electrotherapy Equipment: Properties of x-ray, units of X-ray, production									
of x-Rays, x ray machine, X-ray	image intensifier television system.	Computed Tomograph	hy Principle,						
System component. Electrothera	by equipment-Shortwave diatherm	y machine Microway	e diathermy						
machine, ultrasonic diathermy machine.									
Text Books:									
1. Leslie Cromwell, Fred J. Weibell, Erich Pfeiffer "Biomedical Instrumentation and Measurement"									
PHI. Eastern Economy Edition. Second edition. 2003.									
2. John. G. Webster, "Medical Instrumentation. Application and Design". John Wiley and sons									
publication, Fourth Edition, 2010.									
Reference Books:									
1. R. S. Khandpur. Hand book of	f biomedical Instrumentation. Tata	McGraw Hill publishing	ng Company						
limited, Third Edition, 2014.									

Electrical Drives Laboratory									
LAB COURSE OUTLINE									
Course	Electrica	al Drives Laboratory		Short	EDL	Course	•		
Title:	e:			Title:		Code:			
Course description:									
The course aims to give a practical exposure to Electrical Drive System. It is considered that students									
have prior knowledge of Electrical Machines and Power Electronics. The control techniques for AC and									
DC motors fed converters are discussed. Different applications related to AC and DC drives are also									
highlight	ed.								
Laborate	ory	Hours/week	No. of weeks	Т	otal hours	Semes	ter credits		
		02	14		28		01		
End Sem	ester Exa	m (ESE) Pattern:	Practic	al (PR)					
Prerequisite course(s):									
Electrical Machines, Control System, Power Electronics									
Course objectives:									
The object is to select proper motor for given load characteristic. Selection of motor based on load									
character	istic, electr	rical, mechanical cha	racteristic and serv	vice dut	y. The pr	actical also p	provides the		
knowledg	ge of elect	ric drives, operation	and control of ele	ectrical	drives. Th	ne subject pro	ovides brief		
knowledg	ge of four q	uadrant operation of	drives.						
Course outcomes:									
	the know	uladae of electrical e	e, studelit will be at	in diff	aront onnl	instion of ind	hustrias lika		
1. Appi	facturing	maintenance operation	ingineering subjects		erent appi		iusules like		
2 Understand different speed control methods in DC and AC motors using thuristors based control									
2. Onderstand different speed control methods in D.C and A.C motors using mynistors based control schemes									
3. Understand the characteristic of load and selection of derive in industrial sectors									
4. Conduct practical and analyze data for proper selection of derive in realistic constrain of load									
requirement.									
5. Understand the impact of electrical characteristic of motor in electric traction system.									
LAB COURSE CONTENT									
Electrical Drives Laboratory		Semester:	VII						
Teaching Scheme:		Examination s	Examination scheme						
Practical	:	2 hours/week	End Semester	End Semester Exam (ESE):25 marks			25 marks		
			Internal Conti	Internal Continuous Assessment (ICA): 25 marks		25 marks			
Teacher should facilitate learning following lab experiments:									

- 1. Determination of Speed Torque characteristic of d.c. motor controlled using single phase half controlled rectifier.
- 2. Determination of Speed Torque characteristic of d.c. motor controlled using single phase fully controlled rectifier.
- 3. Performance analysis of one quadrant chopper control of d.c. motor.
- 4. Performance analysis of two quadrant chopper control of d.c. motor.
- 5. Speed control of single phase induction motor using a.c. voltage regulator.
- 6. Study of stepper motor drive circuit.
- 7. Speed control of universal motor.
- 8. Study of closed loop control of d.c. motor.
- 9. Study of vector control method for induction motor.
- 10. Study of reversible drives

Note: Lab file should consist of minimum Eight experiments.

#### **Text Books:**

- 1. G.K. Dubey, "Fundamentals of Electric Drives", Narosa publishing House, 2nd edition, 2002.
- 2. S.K. Pillai, "A First Course on Electric Drives", New Age International Publishers, 3rd edition, 2012.
- 3. B.N. Sarkar, "Fundamental of Industrial Drives", Prentice Hall of India Ltd., 2012.

#### **Reference Books:**

- 1. M. Chilkin, "Electric Drives", Mir Publishers, Moscow.
- 2. Mohammed A. El-Sharkawi, "Fundamentals of Electric Drives", Thomson Asia, Pvt. Ltd. Singapore, 2nd edition, 2017.
- 3. N. K. De, Prashant K. Sen, "Electric Drives", Prentice Hall of India Ltd., 2014.
- 4. V. Subrahmanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill, 1994.

#### Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

#### **Guidelines for ESE:**

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.
LAB COURSE OUTLINE         Course Title:       MATLAB and its Applications Title:       MATLAB LAB Course Code:       Course Code:         Course description:       Title:       MATLAB LAB Title:       Code:       Code:         Course description:       Title:       Code:       Code:       Code:         The objective of this course is to introduce the students to the fundamental concepts of MATLAB and enable them to apply these concepts for simple mathematical problems in MATLAB. This course provides the basic concepts of plot and other useful tools required to solve the problems.       Semester credits         Lecture       01       14       14       02         Laboratory       02       14       28       02         Prerequisite course(s):       Basic sciences, mathematics and subjects of Electrical Engineering, C and C++       Course objectives:         1       To familiarize the student on how to approach for solving Engineering problems using simulation tools.       To provide a foundation in use of this softwares for real time applications.       5         5. To use the MATLAB/Simulink for solving complex engineering problems.       Upon successful completion of lab Course, student will be able to:       1         1. Implement small and medium programs of varying complexity using the most commonly used features of the language.       2       Employ good programming style, standards and practices during program development.         <	MATLAB and its Applications										
LAB COURSE OUTLINECourse Title:MATLAB and its ApplicationsShort Title:MATLAB LAB Course Code:Course Code:Title:Title:CourseCourseCourse description:The objective of this course is to introduce the students to the fundamental concepts of MATLAB this course in datatements required for simple mathematical problems. This course includes the basic structure and statements required for simple mathematical problems in MATLAB. This course provides the basic scncepts of plot and other useful tools required to solve the problems.Semester creditsLecture01141402Laboratory02142802Prerequisite course(SE) Patient (SE) Pattern:Oral (OR)Prerequisite course(SE)Course objectives:1To familiarize the student on how to approach for solving Engineering problems using simulation tools.3. To prepare the student on how to approach for solving complex engineering problems.Voide a foundation in use of this softwares for real time applications.5. To use the MATLAB/Simulink for solving complex engineering problems.Image: Solve Common/Lused features of the language.2. Employ good programming style, standards and practices during program development.3. Solve the different numerical techniques and perform Matrix operations4. Understand and use of MATLAB/Simulink for solving simple electrical engineering problems.5. Use modern engineering tools in MATLAB/Simulink which are useful for analyzing and designing of electrical power system											
Course Title:     MATLAB and its Applications     Short Title:     MATLAB LAB Code:     Course Code:       Title:     Image: Conde:     Code:		<u> </u>	LA	B COU	RSE OUTI						
Title:       Title:       Code:         Course description:       Code:       Code:         The objective of this course is to introduce the students to the fundamental concepts of MATLAB and the abaic and problems. This course includes the basic structure and statements required for simple mathematical problems in MATLAB. This course provides the basic concepts of plot and other useful tools required to solve the problems. This course provides the basic concepts of plot and other useful tools required to solve the problems.         Lecture       Uours/week       No. of weeks       Total hours       Semester credits         Laboratory       02       14       28       Prerequisite course(s):       Basic sciences, mathematics and subjects of Electrical Engineering, C and C++       Course objectives:       Prerequisite course(s):       Semester credits.         1. To familiarize the student in introducing and exploring MATLAB/Simulink.       2. To enable the students to use MATLAB/Simulink in their project works       4. To provide a foundation in use of this softwares for real time applications.       5. To use the MATLAB/Simulink for solving complex engineering problems using simulation tools.         3. To prepare the student on flab Course, student will be able to:       1. Implement small and medium programs of varying complexity using the most commonly used features of the language.       Selve the different numerical techniques and perform Matrix operations.         4. Understand and use of MATLAB/Simulink for solving simple electrical engineering problems.       Solve the different solve system	Course	MATLAI	B and its Applicatio	ns	Short	MATLAB LAB	Course	e			
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### Theory:

# Unit–I: Introduction to Matlab/Simulink

Standard Matlab windows, Operations with variables: naming, checking existence, clearing and operations, Arrays: columns and rows: creation and indexing, size & length, multiplication, division, power and operations.

# Unit–II: Writing script

Writing script files: logical variables and operators, flow control and loop operators

Writing functions: input/output arguments, function visibility, path and Matlab Startup Simple graphics : 2D and 3D plots and figures and subplots

# Unit-III: Data and data flow in Matlab

Data types: Matrix, string, cell and structure, creating, accessing elements and manipulating of data of different types. File Input-Output: Matlab files, text files, binary files, mixed text-binary files.

# **Unit–IV: Introduction to Simulink**

Simulation steps, Types of mathematical model, developing a model, Simulink solution of differential equation, solvers, Assigning variables, Observing variable during simulation. Storing or saving data, linking script file with model file, Data import/export, Creating and masking subsystems

# Unit-V: Applications of MATLAB/Simulink

Simulation of R-L-C series circuit, Finding laplace transform and inverse laplace transform using MATLAB, Step response using MATLAB, Root locus and Bode plot, Simulation of Single phase half wave and full wave rectifiers, battery charger, Effect of source inductances, Simulation of controlled converters and AC voltage controller.

Teacher should facilitate learning following lab experiments:

- 1. A. Simple Arithmetic Calculation: Perform simple arithmetic calculations:
  - a. Addition, subtraction, multiplication, division and exponentiation.
  - b. Assign values to variables.
  - c. Suppress screen output.
  - d. Control the appearance of floating point numbers on the screen.
- 2. Create: Simple sine plot, line plot, an exponentially decaying sine plot, space curve, log scale plot, Overlay plot and Fancy plots.
- 3. Write a program to find transient response in RC and RL circuit.
- 4. Write a program to plot voltage and current in inductive and capacitive circuit
- 5. Build a simple circuit with Power System blocks and connect it to other Simulink Blocks
- 6. Create an electrical subsystem, simulate transients, and discretize simple circuits
- 7. Single phase fully controlled converter using R and RL load using MATLAB /Simulink.
- 8. Single phase AC voltage regulator using MATLAB / SIMULINK
- 9. Step response without and with derivative control
- 10. Obtain the step and ramp response of the control system.

Note: Lab file should consist of minimum Eight experiments.

### **Text Books:**

1. Dr. Shailendra Jain, "Modeling & Simulation using MATLAB-Simulink", Wiley India, 2013.

2. Rudra Pratap, "Getting Started With Matlab: A Quick Introduction For Scientists And Engineers" Oxford University Press, 2011.

### **Reference Books:**

- 1. Using MATLAB Graphics, Version 10, The Math Works, Inc., 2012.
- 2. MATLAB Release Notes for Release 12, The Math Works, Inc., 2012.
- 3. Sivanandam S.N., Sumathi S., Deepa S. N., "Introduction to Fuzzy Logic using MATLAB", Springer-Verlag Berlin Heidelberg, 1st edition, 2007.
- 4. S. Sivanandam, S. Sumathi, "Introduction to Neural Networks Using MATLAB", McGraw Hill Education, 1st Edition, 2017.

# Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

### **Guidelines for ESE:**

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

Project (Stage – I)										
LAD COUDSE OUTLINE										
Course Title:	Project (Stag	e - I	Short	PROJ-SI	Course					
Course description:			I itle:		Code:					
Project represents the culmination of study towards the Bachelor of Engineering degree. The project										
offers the opportunity to apply and extend material learned throughout the program. The emphasis is										
necessarily on facilitating student learning in technical, project management and presentation spheres.										
Laboratory	Hours/week	No We	o. of eeks	Total hours	Semeste	er credits				
	12		14	168	(	)6				
End Semester Exam (E	SE) Pattern:			Oral (OR)						
Prerequisite course(s):										
Course objectives:										
1. To understand the basic concepts & broad principles of projects.										
2. To understand the v	alue of achieving per	fection	in proje	ct implementation	& completion	on.				
3. To apply the theoret	ical concepts to solve	proble	ms with	teamwork and mul	ltidisciplinar	y approach.				
4. To demonstrate pro	ofessionalism with ef	thics; I	present e	effective communi	cation skills	and relate				
engineering issues to	o broader societal cor	itext.								
Course outcomes:										
Upon successful complet	ion of lab Course stu	ident w	vill be ab	le to:						
1 Demonstrate a soun	d technical knowledg	e of the	eir select	ed project topic						
2. Undertake problem	identification formul	ation a	nd soluti	ion						
3. Design engineering	solutions to complex	proble	ms utiliz	ing a systems appr	oach.					
4. Conduct an engineer	ring project	r		<i>8 </i> , <i></i>						
5. Demonstrate the know	owledge, skills and at	titudes	of a pro	fessional engineer.						
	LAB CC	OURSE	CONT	ENT						
Project (Stage – I)		Seme	ster:		VII					
Teaching Scheme:		Exan	nination	scheme:						
Practical:	12 hours/week	End Semester Exam (ESE): (OR		DR)	50 marks					
		Inter	nal Con	tinuous Assessme	nt (ICA):	50 marks				
						1				
At the final year the stude	ents shall carry out a p	roject i	n a group	o of maximum up to	o 5 students.	The project				
work spans both the seme	esters. By the end of S	emeste	r - VII th	ne students shall co	mplete the p	artial work,				

and by the end of Semester – VIII the students shall complete remaining part of the project. Assessment for the project shall also include presentation by the students. Each teacher can guide maximum 04 groups of projects.

The students should take project work, as specified in the curriculum, based on the knowledge acquired by the students during the degree course till Semester – VI and/or during Internship. The project shall involve both theoretical and practical work to be assigned by the Department. The work may also be on specified task or project assigned to the students during Internship or R & D work.

Project (Stage – I) may involve literature survey, problem identification, work methodology preparing specification and material procurement, collection of data etc. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design or analysis. Approximately more than 50% work should be completed by the end of Semester – VII. Each student group should submit partial project report in the form of thermal bound at the end of Semester –VII. Each student group is required to maintain separate log book for documenting various activities of the project.

# **Guide lines for ICA:**

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge / skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project (stage – I) in Semester – VII shall be as per the guidelines given in Table – 1.

#### Table – 1

			Assessi	ment by Guid	Assessment by I Comm				
Sr. No.	Name of the Student	Attendance /     Problem     Literature     Methodology     Report       Participation     Identification     Survey     / Design     Report       / Project     Objectives     Objectives     Image: Comparison of the survey     Image: Comparison of the survey				Depth of Understanding	Presentation	Total	
	Marks	5	5	5	5	5	10	15	50

# **Guidelines for ESE:**

In End Semester Examination (ESE), the student may be asked for presentation/demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

# **Essence of Indian Traditional Knowledge**

### **Course objective:**

The course aims at imparting basic principles of thought process, reasoning and inferencing, sustainability is at the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. The course focuses on introduction to Indian knowledge systems, Indian perspective of modern scientific world-view, and basic principles of yoga and holistic health care system, Indian artistic tradition.

### **Outcomes:**

Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

# **Course Contents:**

Introduction to:

- Ayurveda, Charaka Samhita, Sushruta Samhita Principles and Terminology: Vatha, Pitha, Kapha, Ether, Earth, Water, fire and Air Tatva, Influence of these on human health.
- 2. Architecture: Temple Architecture, Indo Islamic Architecture, Mughal Architecture, Indian Rock Cut Architecture, Vastu Shastra.
- 3. Importance of Yoga for Physical and Mental health, Yoga Sutras of Patanjali, Meditation, International day of Yoga.
- 4. Indian Classical Music, Hindustani and Carnatic Music, Raga, Tala, Dhrupad, Khyal, Tarana and Thumri, Sangitaratnakara, Work of Tansen, Purandara Dasa, Bhimsen Joshi, Ustad Bismillah Khan, Bal Gandharva etc. Folk Music and Dances such as Rajasthani, Marathi, Gujrati, Punjabi etc.
- 5. Indian Classical Dances: Shastriya Nritya, Natya Shastra, Bharatanatyam, Kathak, Kuchipudi, Odissi, Kathakali, Sattriya, Manipuri, Mohiniyattam and Chhau dance forms.

### **References:**

- 1. Amit Jha, "Traditional knowledge system in India", Atlantic Publisher, ISBN 978812691223
- Basanta Kumar Malhotra, "Traditional Knowledge System and Technology in India", Pratibha Prakashan, ISBN 8177-023101
- 3. Nitin Singhania, "Indian Art and Culture", McGraw Will Publication.
- Dr. Bramhand Tripathi, "Charak Sanhita", Chaukhambha Surbharti Prakashan, ISBN: 9381-4847-59
- 5. Dr. Anantram Sharma, "Sushrut Samhita"
- 6. Valiatham M.S., "An Introduction to Ayurveda" Orient Bkackswan Publication.
- 7. Valiathan M.S., "The legacy of Charaka" University Press.
- 8. Valiathan M.S., "The legacy of Susruta" University Press.
- 9. Garg Maheshwari, "Ancient Indian Architecture", CBS Publisher and Distributors
- 10. Sharmin Khan, "History of Indian Architecture", CBS Publisher and Distributors.
- 11. Bindia Thapar, Surat ku. Manto, Suparana Bhalla, "Introduction to Indian Architecture", Periplus Editions Ltd.
- 12. Vijay Prakash Singh, "An Introduction to Hindustani Classical Music", Lotus Publisher
- 13. Leeta Venkataraman, Avinash Pasricha, "Indian Classical Dance" Lustre Publisher
- 14. Shovana Narayan, "Indian Classical Dances" New Dawn Press
- 15. Kapila Vatsyayan, "Indian Classical Dance", Ministry of Information and Broadcasting, Govt of India.
- 16. Mahadevan Ramesh, "A Gentle introduction to Carnatic Music", Oxygen books Publisher.

# Kavayitri Bahinabai Chaudhari NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

# Syllabus for

# **Final Year Electrical Engineering**

Faculty of Science and Technology



# **COURSE OUTLINE**

# Semester – VIII

# w. e. f. 2020 – 21

Power System Protection										
Course	Dowon	Suct	m Protoction	COUL	KSE OUI	Short	DCD		011800	1
Title.	Power	Sysu	em Protection	l		Short Title	rsr		ode.	
Course de	scriptio	n·				1100.			ouc.	
A protection scheme in a power system is designed to continuously monitor the power system to ensure										
maximum continuity of electrical supply with minimum damage to life equipment and property. The										
subject ex	subject explores the knowledge of arc interruption different type of circuit breakers and relay. This									
knowledge	e is help	full	for understand	ling the	character	istic feature	e and prop	er selecti	on of pro	otective
elements i	n differe	ent pro	otective schem	e. The s	ubject als	so provides	knowledge	e differen	t protect	ion for
major and	individu	al po	wer system ele	ements.	5	1	e		I	
Lecture		H	ours/week	No. of	f weeks	Tot	al hours	Se	mester c	redits
	-		03	1	14		42		03	
Prerequisite course(s):										
Power Sys	tem-I, P	ower	System-II							
Course ob	jectives	:	-							
The objectives of subject are that students will able understanding the fault characteristic of individual										
power syst	tem elem	nents.	One should als	so be kno	owledgeal	ble about th	e tripping c	haracteria	stics of v	arious
protective	relays. T	The stu	idents able to u	ınderstar	nd the job	of protectio	n engineer	is to devis	se such so	cheme
where clos	est possi	ible m	atch between t	he fault c	characteris	stic and trip	ping charac	teristic is	obtained	d. The
students w	ill able t	o und	erstand protect	ted zone	and able t	o design pr	otective sch	ieme such	n that rela	ıy will
detect und	esirable	condi	itions and then	trip to	disconnec	t the area a	ffected, but	t remain r	estrained	l at all
other time.	. Student	t shou	ld be equipped	l with so	und conce	ept of powe	r system pi	otection	to enable	those
handling u	nforesee	en circ	cumstances in	real life.						
Course ou	itcomes	:								
After succ	essful co	omple	tion of this cou	arse the s	student wi	ill be able to	):			
1. Appl	y the bas	sic kno	owledge of sci	ence for	understar	nding arc ge	neration an	d interruj	ption in n	nedium
and h	igh volta	age cu	rcuit.	1		1.00		1.		
2. Discu	iss const	ructio	on operation an	a specifi	cations of	different ci	rcuit break	ers used ii	n power s	system.
3. Defin	le basic i	relay a	and their role i	n protect	tion system	m.	tion schom			
4. State	differen	t prot	ection scheme	used in a	nower sys	ne ili protec	stion schem	e.		
5. State different protection scheme used in power system.										
COURSE CONTENT										
Power System Protection Semester: VIII										
Teaching Scheme: Evamination scheme										
Lacturase	Scheme	•	3 hours/wool	7	End So	mostor Evo	m (FCF).		60 mar	lze
Lectures:			5 nours/week	N	End Sel	mester EXa	m (ESE):		ov mar	U9

	Duratio	ı of ESE	:	03 hours				
	Internal	Sessiona	l Exams (ISE):	40 marks				
Unit–I:	No. of Lectures: 08 l	Iours	Marks:	12				
Arc Phenomena and Interruption	<b>h:</b> Basic requirement	of Switch	ing and protection, a	rc phenomenon,				
maintenance of arc, properties of arc	, interruption theories	, transien	t recovery Voltage, tra	ansient analysis,				
RRRV, Interruption of capacitive current, current chopping.								
Unit–II:	No. of Lectures: 08 l	Iours	Marks:	12				
Circuit Breakers and Fuses: Construction & Operation, class, breaking capacity, characteristic and								
application of: Minimum oil circuit b	breaker, air blast circu	t breaker	, SF6, Vacuum Circuit	Breaker, Earth				
leakage & Miniature circuit breaker,	HRC fuses and HVL	C circui	t breaker.					
		•		10				
	No. of Lectures: 08 I	lours	Marks:	12				
Protective Relay-I: Protection syste	m and its attributes:	sensitivi	ty, selectivity, speed,	reliability and				
Construction working and characte	ristic features of alac	n, zones	tic relev: Over curren	t instantanaous				
over current definite time over curr	ant inverse time over		elay directional over o	urrent relay and				
differential relay	ent, inverse time over	-current r	ciay, un ectional over e	unent relay and				
differential felay.								
Unit–IV:	No. of Lectures: 09 1	Hours	Marks:	12				
Protective Relay-II: Construction, we	orking and characteris	tic feature	es of electromagnetic r	elay: Impedance				
relay, reactance relay, Mho relay ar	nd their trip law using	universa	l torque equation. Sta	tic Over current				
relay: Single and double actuating	g quantity relay, bas	ic princi	ple of static over cu	rrent relay and				
directional over current relay.			•					
Evolution Digital relay: basic cor	nponent of digital r	elay, dig	ital sub units digital	relay as unit.				
Microprocessors based relay, block of	diagram, relay for mot	or and ad	vantages.					
Unit–V:	No. of Lectures: 09 1	Iours	Marks:	12				
Protection Schemes: Different ty	ype of protective sc	heme: O	ver current protection	on, Differential				
protection, earth fault protection, dis	stance protection and	carrier ai	ded protection. Protec	tive scheme for				
generator, transformer, bus-bar, tran	smission line and mot	or.						
Text Books.								
1 Sunil S Rao "Switchgear Prot	tection and Power Sw	tems" K	hanna Publishers 1/t	adition 2010				
1. Sum S. Rao, Switchgear 110	teetion and I ower Sys	, K		cutton, 2019.				
Rafaranca Baaks:								
1. Y.G. Paithankar, S.R. Bhide, "F	FundamentalsofPowe	SystemF	Protection". PHI Publi	cations. Second				
Edition. 2013.		b y stelli		cations, second				
2 TS Madharao "Power System Protection: Static Palays with Microprocessor Applications" Tata								
2. 1.5. Madnarao, "Power System Protection: Static Kelays with Microprocessor Applications", Tata McGrawHill Second Edition 2017								
3. B. Ravindranath M Chand	3 B Ravindranath M Chandar "Power System Protection & Switchgear" New Age							
3. B. Ravindranath, M. Chandar, "Power System Protection & Switchgear", New Age								

- 4. B. Ram, D.N. Vishwakarma, "Power System Protection & Switch Gear", Mc Graw Hill Education, Second Edition, 2017.
- 5. Stanley H. Horowitz, Arun G. Phadke, "Power System Relaying", Wiley Blackwell Publications, Third Edition, 2008.
- 6. J.B. Gupta, "Fundamentals of Switchgear and Protection", S.K. Kataria and Sons Publishers, 2013.
- 7. <u>http://nptel.iitm.ac.in</u>

Flex	Flexible AC Transmission System and Power Quality (Professional Elective Course – V)									
	r		COURSE	OUTLIN	E		1			
Course	Flexible	AC Transmission S	System and	l Power	Short	FPQ	Cours	e		
Title:	Quality				Title:		Code:			
Course d	escriptior	1:								
Flexible AC Transmission System (FACTS) is one aspect of the power electronics revolution that is										
taking place in all area of electric energy. In the transmission area, application of power electronics										
consists of HVDC and FACTS. Is a new technology based on power electronics offers an opportunity to										
enhance of	enhance controllability, stability and power transfer capability of AC transmission system. The subject									
I octure	ores the kn	Hours/wook	No of		Ce of pov	wer quar	ny.	stan anadita		
Lecture		Hours/week	INO. 01	weeks	101		Seme			
<b>D</b> •	• /	03		4		42		03		
Prerequi	site cours	e(s):								
Power Sy	stem, Pow	ver Electronics								
Course o	bjectives:	1 1 .	1' C (1	. 1	1	6.0		<b>.</b>		
This could	se will de	velop an understand	ling of the	control an	d operati	ion of F	lexible AC	Transmission		
system.	ne effect	of different FACIs	devices to	the opera	tion and	control	of power sy	stem will be		
presented	1.1  ms col	irse also studies the	e ennancen	frent of co		inty, stat	onity and po	ower transfer		
capability	OI AC tr	ansmission system.	Study the	rundament	al concej	pt of po	wer quality	and different		
power qu	anty issues	8.								
Course o	utaamaa									
After suc	constul cor	mulation of this cour	so the stud	ont will bo	abla to:					
	v basic kno	awledge power elect	ronic for er	hancing n	ower trar	sfor car	ability of A	r		
1. Appi	y basic Kill	stem		maneing p	ower trai	isiei cap	aunity of A	-		
2 Unde	rstand EA	CTS concents its lo	cation in tr	anemiesion	network					
$\frac{2}{3}$ Analy	vze the ch	eracteristics FACTS	controller :	and able to	solve en	σineerin	g problems			
4 Unde	rstand the	sources of harmonic	e and its m	itigation	solve en	gineerin	g problems.			
5 Disch	narging du	ties as power system	engineer i	n technical	and prof	essional	way			
	anging aa	ties us power system			una proi	055101141	i way.			
			COURSE	CONTEN	Т					
Flexible	AC Trans	mission System and	d Power	Semester	r:		VIII			
Quality		j								
Teaching	g Scheme:			Examination scheme						
Lectures	•	3 hours/weel	K	End Semester Exam (ESE): 60 max			60 marks			
				Duration of ESE: 03 h			03 hours			
				Internal	Sessiona	al Exam	s (ISE):	40 marks		
	Unit–I	: N	o. of Lectu	tures: 08 Hours Marks: 12				2		
<u>.</u>		1			I					

**FACTS Concept:** Transmission interconnection and opportunity for FACTS, Basic type of FACTS controller, Brief description of FACTs controller: Shunt, series and combination of shunt and series. Comparison of HVDC and FACTS.

Unit–II:	Marks: 12								
Static Shunt Compensators: SVC and STATCOM: Object of shunt compensation, Midpoint voltage									
regulation for line segmentation, end of line voltage support. Method of controllable VAR generation:									
variable impedance type and switching type VAR generators, STATCOM.									

Unit–III:	No. of Lectures: 09 Hours	Marks: 12							
Static Series Compensators: (	Objectives of Series Compensation	on: Concept of series capacitive							
compensation, voltage stability. Variable impedance type series compensators: Thyristor switched series									
capacitor (TSSC) and Thyristor controlled series capacitor (TCSC).									

Unit-IV:No. of Lectures: 09 HoursMarks: 12Power Quality: Power quality definition, need for power quality, nonlinear loads, Type of power quality<br/>problems: voltage sags, voltage swells, under-voltage, interruption, transients, voltage unbalance,<br/>voltage fluctuation, harmonics and electrical noise. Sources of power quality problems.

Unit–V:	No. of Lectures: 08 Hours	Marks: 12							
Power Quality effects and Solutions: Effect of harmonics in pure resistive, inductive and capacitive									
circuit, effect of harmonic on in	nduction motor, transformer, pow	er factor correction and lighting							
nstallation. Power quality standard and mitigation by active and passive filter.									

# **Text Books:**

- 1. N. G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1st edition, 1999
- 2. K. R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International Pvt Ltd; 2nd edition, 2016.
- 3. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 3rd edition, 2017.

### **Reference Books:**

1. T. J. E. Miller, "Reactive Power Control in Electric Systems", Wiley India Pvt Ltd., 2010.

2. G. T. Heydt, "Electric Power Quality", Stars in Circle Publications, 2nd edition, 1991.

Power Converter Applications (Professional Elective Course – V)										
COURSE OUTLINE										
Course	Power C	onverter Application	ns		Short	PCA	Course			
Title:					Title:		Code:			
Course description:										
Power electronics converters stresses a power semiconductor devices beyond the rating, how to relieving										
the problems. Power electronics has already found an important place in modern technology and has										
revolutionized control of power and energy. As the voltage and current ratings and switching										
character	istics of po	ower semiconductor d	levice	s keep improvi	ng, the ra	ange of app	lications co	ntinues to		
expand i	n areas s	uch as lamp control	ls, po	ower supplies	to motio	on control,	factory au	tomation,		
transporta	ation, ener	gy storage, megawa	tt ind	ustrial drives,	photovo	ltaic syster	n and electr	ric power		
transmiss	ion and di	stribution. The syllab	ous of	Power Conver	ter Appl	ications dea	als with Swi	itching dc		
Power St	upply, Pov	wer conditioners and	l Uni	nterruptible Po	ower Sup	plies, resid	lential and	industrial		
applicatio	ons and pro	ogrammable power ele	ectron	ic system etc.						
Lecture		Hours/week	N	o. of weeks	Tota	l hours	Semeste	r credits		
		03		14		42	0	3		
Prerequisite course(s):										
Power El	ectronics									
Course o	bjectives:									
Power El	ectronics j	provides the interface	e betv	ween two majo	or divisio	ns of elect	rical engine	ering viz.		
electric p	ower and e	electronics. It is the art	t of co	onverting electr	ical energ	gy from one	form to and	other in an		
efficient,	clean, co	mpact and robust m	nanner	r for convenie	ent utiliza	ation. The	objectives	of Power		
Converter	r Applicati	ons is to create an av	varene	ess about the g	eneral na	ture of Pow	er electroni	c devices,		
key featu	res of vari	ous industrial applica	ations	, the most imp	ortant an	ong them	being high-v	voltage dc		
transmiss	ion, static	VAR control, switch	h mo	de power supp	lies and	programma	able power	electronic		
system.										
Course o	utcomes:									
After suc	cessful cor	npletion of this course	e the	student will be	able to:					
1. Ana	lyze and de	esign of switch mode	powe	r supplies.						
2. Dese	cribe the	role of Power condi	tioner	s and Uninter	ruptible	Power Sup	plies as an	enabling		
tech	nology in v	various applications.								
3. Und	erstand the	e utilization of power	conve	erters for reside	ntial app	lications.				
4. Understand the utilization of power converters for industrial applications.										
5. Describe the control strategies of power converters using microcontroller and DSP processor.										
COURSE CONTENT										
rower C	onverter A	Applications		Semester:		V	11			
Teaching	Teaching Scheme: Examination scheme									

Lectures:	3 hours/	week	End Semester Exam (ESE):60 marks						
			<b>Duration of ESE:</b>		03 hours				
			Internal Sessional I	Exams (ISE):	40 marks				
Unit–I:		No. of L	ectures: 09 Hours	Marks:	12				
Switching dc Power St	upply: Li	near power	supply, Overview of	of switching power s	upply, dc-dc				
converters with electrical	1 isolation	, Control of	f switch-mode power	supply, Power supply	ly protection,				
Electrical isolation in fee	dback loop	o, Designing	g meet the power supp	bly specifications.					
Unit-II:		No. of L	ectures: 09Hours	Marks:	12 D				
<b>Power conditioners and Uninterruptible Power Supplies:</b> Power line disturbances, Power and disturbances, Power supplies on line off line									
Ligh Voltage de Transmi	ible Power	r Supplies: (	On-line, off line.	a VAD control					
rigii-voltage de Traisili									
Unit_III: No. of Lectures: 08 Hours Marks: 12									
Residential Applications	s: Static sv	vitch using	Thyristor Static switch	h using Traic DC stati	ic switch low				
power flasher. Solid-state	e relavs. Li	ight dimmer	. Electronic timer. Ele	ectronic alarm. Electro	nic Crowbar.				
Battery charger, Battery c	charging re	egulator, En	nerging lighting system	n.	· · · · · · · · · · · · · · · · · · ·				
Unit-IV:		No. of L	ectures: 08 Hours	Marks:	12				
Industrial Applications: Temperature control, Liquid-level control, Alarm actuator, Ambient-light									
control power switch, Con	nstant slop	e ramp gene	erator, High frequency	welding system, Indu	ction heating				
system.									
				1					
Unit–V:		No. of L	ectures: 09 Hours	Marks:	12				
Programmable Power E	lectronic	System: M	icroprocessor based fi	ring circuit for thyriste	or converters,				
Microprocessor based of	electric di	rives, Micr	oprocessor based sp	beed control of an	AC motors,				
Microprocessor based pr	ocess cont	trol system,	DSP based control,	Fuzzy logic control c	of DC drives,				
Fuzzy logic control of an	Induction	motor, Fuzz	zy logic control of a s	tepper motor.					
Text Books.									
1 Ned Mohan Tore M	[ Undelan	d William	P Robbins "Power El	ectronics: Converters	Applications				
and Design". John V	Wilev & So	ons. Third E	dition. $2014$ .		ripplications				
2. V. R. Moorthy, "Pov	wer Electro	onics Device	es Circuit and Industria	al Applications", Oxfo	rd University				
Press, First Edition,	2015.				2				
3. Alok Jain, "Power H	Electronics	and its Ap	plications", Penram In	nternational Publishing	g (India) Pvt.				
Ltd., Third Edition,	2016.								
Reference Books:									
1. L. Umanand, "Powe	r Electron	ics: Essentia	als and Applications",	Wiley India, 2014.					
2. Philip T. Krein, "El	ements of	Power Elec	ctronics", Oxford Uni	versity Press, Internat	ional Second				
Edition, 2016.	1 -	0.4 5.1	1070						
3. SCR manual, Gener	al Electric	, Sixth Editi	ion, 1979.						

	HVDC Transmission Systems (Professional Elective Course – V)								
			~	ound	0.1177.13				
G		<b>.</b>		OURSE	OUTLIN	E			
Course	HVDC	ransmission	Systems			Short	HVDCIS	Course	
The:	osciption					The:		Coue:	
This course introduces the fundamental concents, principles; analysis and design of high voltage direct									
current transmission system. Modern DC power transmission is relatively new technology because of									
advent of thyristor valves and related technology. The HVDC technology is still undergoing many									
changes of	changes due to continuing innovations directed at improving reliability and reducing cost of converting								
station. T	he subject	explores the k	nowledg	e of HVI	D in econo	omic and	technical con	nstraint.	0
Lecture	· ·	Hours/we	ek	No. of	weeks	Tota	al hours	Semest	er credits
		03		14	4		42		03
Prerequi	site cours	e(s):							
Power Sy	stem, Pow	ver Electronics							
Course o	bjectives:								
1. To u	1. To understand the concept, planning of DC power transmission and comparison with AC Power								
transi	mission.								
2. To ar	nalyze HV	DC converters							
3. To st	udy about	the HVDC sys	stem cont	trol.					
4. To an	nalyze volt	age stability p	roblem ir	n DC sys	tem.				
5. To m	odel and a	nalysis the DC	System	under stu	idy state.				
G									
Course o	utcomes:			(1 (		-1.1. (			
After suc	cessiul col	mpletion of thi	s course	the stude	ent will be	able to:			
1. Unde	rstand the	advantages of operation of I	ine Com	mission ( mutated	over ac tra	nsmissioi 's and Vo	1. Itage Source	Converter	c
3. Unde	rstand the	control strateg	gies used	in HVD	C transmis	s and vo	em.	Converter	5.
4. Unde	rstand the	improvement	of power	system s	stability u	sing an H	VDC system	1.	
5. Unde	rstand the	multi terminal	HVDC	transmiss	sion syster	n.			
			CO	OURSE	CONTEN	NT			
HVDC T	ransmissi	on Systems			Semeste	r:	VII	Ι	
Teaching	g Scheme:				Examination scheme				
Lectures	•	3 hours	s/week		End Semester Exam (ESE):60 ms				60 marks
					Duration	n of ES <mark>E</mark>	•		03 hours
					Internal Sessional Exams (ISE):40			40 marks	
Unit-I: No. of Lo			No. o	of Lectur	res: 08 Ho	ours	Ν	Aarks: 12	

**DC Transmission Technology:** Comparison of AC and DC Transmission (Economics, Technical Performance and Reliability). Application of DC Transmission. Types of HVDC Systems. Components of HVDC system. Line Commutated Converter and Voltage Source Converter based systems.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12
Analysis of Line Commutated	and Voltage Source Converter	s: Line Commutated Converters
(LCCs): Six pulse converter, An	nalysis neglecting commutation o	verlap, harmonics, Twelve Pulse
Converters. Inverter Operation. Ef	fect of Commutation Overlap. Expr	ressions for average dc voltage, AC
current and reactive power absor	bed by the converters. Effect of C	Commutation Failure, Misfire and
Current Extinction in LCC links. V	Voltage Source Converters (VSCs):	Two and Three-level VSCs. PWM
schemes: Selective Harmonic Elir	nination, Sinusoidal Pulse Width M	Iodulation. Analysis of a six pulse
converter. Equations in the rotatin	g frame. Real and Reactive power of	control using a VSC.

Unit–III:No. of Lectures: 08 HoursMarks: 12Control of HVDC Converters: Principles of Link Control in LCC HVDC system. Control Hierarchy,Firing Angle Controls– Phase-Locked Loop, Current and Extinction Angle Control, Starting andStopping of a Link. Higher level Controllers Power control, Frequency Control, Stability Controllers.Reactive Power Control. Principles of Link Control in a VSC HVDC system: Power flow and dc VoltageControl. Reactive Power Control/AC voltage regulation.

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12

**Components of HVDC systems:** Smoothing Reactors, Reactive Power Sources and Filters in LCC HVDC systems DC line: Corona Effects. Insulators, Transient Over-voltages. DC line faults in LCC systems. DC line faults in VSC systems. DC breakers. Monopolar Operation. Ground Electrodes. Stability Enhancement using HVDC. Basic Concepts: Power System Angular, Voltage and Frequency Stability. Power Modulation: basic principles – synchronous and asynchronous links. Voltage Stability Problem in AC/dc systems.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12
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**MTDC Links:** Multi-Terminal and Multi-In feed Systems. Series and Parallel MTDC systems using LCCs. MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

### **Text Books:**

- 1. K. R. Padiyar, "HVDC Power Transmission Systems", New Age International Publishers, 3rd edition, 2017.
- 2. S. Rao, "EHVAC & HVDC Transmission Engineering & Practice", Khanna Publications, 3rd edition, 1993.

- 1. J. Arrillaga, "High Voltage Direct Current Transmission", Institution of Electrical Engineers, 2nd edition, 2008.
- 2. E. W. Kimbark, "Direct Current Transmission", Vol.1, Wiley-Interscience, 1971.

<b>Power System Restructuring (Professional Elective Course – V)</b>									
	I		COURSE OUTLIN	JE	I	1	I		
Course	Power Sy	/stem Restructuring Short PSR Course							
Title:				Title:		Code:			
Course d	lescription	:							
The restr	ucturing of	power industry has ch	nanged the way of ope	eration of	the power s	ystems. Alo	ong with the		
secured a	and reliable	operation of power sy	ystems, the economic	efficienc	ey has becom	ne an equal	ly important		
considera	tion. Unlik	ke the knowledge of	conventional opera	tion of	power system	ms, unders	tanding the		
restructur	red power s	ystems requires basic	knowledge of electric	cal engin	eering, powe	er systems,	and also the		
economic	es. This cou	rse is intended to prov	vide a comprehensive	e treatmer	nt towards un	derstanding	g of the new		
dimensio	ns associate	ed with the power syst	ems. The course will	initially b	oring out the o	lifferences	between the		
conventio	onal power	system operation an	d the restructured or	ne. Befor	re tackling ta	axing issue	es involving		
techno-co	ommercial s	solutions, the course w	vill prepare a backgro	und with	fundamental	s of microe	conomics.		
The desig	gn of power	markets and market	architectural aspects	will be di	scussed next	. With this	foundation,		
the chang	ges in operat	tional aspects with nev	w operational challeng	ges like co	ongestion ma	nagement a	and ancillary		
service n	nanagement	will be elaborated. E	Efficient pricing of tra	ansmissic	on network us	sage is a m	ust to bring		
economic	e efficiency	in the power market	operation. These iss	ues will	follow next.	There will	be separate		
modules	on Genco l	bidding strategies and	market power with	mitigatio	n techniques	. Towards	the end, the		
discussio	n on restruc	cturing experiences of	different countries al	l around	the world wil	ll be provid	led.		
Also, the	re will be ex	clusive module on rel	form practices in deve	eloping co	ountries with	special foc	us on Indian		
power sys	stem. The c	ourse will be enriched	with solved example	s in order	to illustrate	various con	cepts. Also,		
case stud	ies on deep	ly researched topics w	ill be provided. The e	emphasis	of the course	will be on	bringing out		
new conc	epts in a sin	mple and lucid manne	r.	1		1			
Lecture		Hours/week	No. of weeks	Tota	al hours	Semest	er credits		
		03	12		42		03		
Prerequisite course (s):									
Power System I, Power System II									
Course objectives:									
1. To educate students about the process of restructuring of power system									
2. To f	familiarize s	students about the ope	ration of restructured	power sy	/stem				
3. To t	each studer	nts pricing of electricit	y.						
4. To gain knowledge of fundamental concept of congestion management									

- 5. To analyze the concept of location marginal pricing and transmission rights.
- 6. To provide in-depth understanding of operation of deregulated electricity market systems.

### **Course outcomes:**

After successful completion of this course the student will be able to:

- 1. Describe various types of regulations in power systems.
- 2. Identify the need of regulation and deregulation.
- 3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
- 4. Identify and give examples of existing electricity markets.
- 5. Classify different market mechanisms and to summarize the role of various entities in the market.

	COUDCE	CONTENT				
Dowon System Destructu			VIII			
Fower System Restructu	iring	Semester:	VIII			
Teaching Scheme:		Examination scheme				
Lectures:	3 hours/week	End Semester Exam (ES	E):	60 marks		
		Duration of ESE:		03 hours		
		Internal Sessional Exam	s (ISE):	40 marks		
Uni	t–I:	No. of Lectures: 09 Ho	urs I	Marks: 12		
Power Sector in India: In	stitutional structure before	reforms. Roles of various ke	y entities in I	ndia. Necessity		
of Deregulation or Restruc	cturing. RC Act 1998 and E	lectricity Act 2003 and its in	nplications fo	r Restructuring		
& Deregulation. Instituti	onal structure during refe	orm. National Energy poli-	cy. Introduct	ion to Energy		
Exchange and trading of I	Renewable Energy Credits	and Carbon Credits.				
Unit	t–II:	No. of Lectures: 08 Ho	urs I	Marks: 12		
Fundamentals of Econo	omics: Introduction to van	rious concepts such as cap	pital cost, de	bt and equity,		
depreciation, fixed and va	riable costs, working capit	al, profitability indices etc.	Typical cost	components of		
utilities such as return in	equity, depreciation, interest	st and finance charges, O an	nd M expense	es. Key Indices		
for assessment of utility p	erformances. Principles of	Tariff setting, Phases of Tar	iff determina	tion, consumer		
tariff & non-price issues.						
Unit	-III:	No. of Lectures: 08 Ho	urs I	Marks: 12		
Power Sector Regulation	on and Congestion Issues	Regulatory process in Ir	ndia, types a	nd methods of		
Regulation, cost plus, pe	erformance-based regulation	on, price cap, revenue cap	regulation,	rate of return		
regulation, benchmarking	or yardstick regulation. R	ole of regulatory commissi	on. Consider	ations of socio		
economic aspects in regul	ation.					
Congestion in power net	work, reasons for congest	tion, classification of cong	sestion managed	gement, useful		
definitions. Methods of c	ongestion management, Lo	ocational Marginal Pricing	(LMR), Firm	n Transmission		
Right (FTR). Availability	based Tariff (ABT) in Indi	a.				
Unit	IV:	No. of Lectures: 08 Ho	urs I	Marks: 12		
<b>Restructuring:</b> Introduction, models based on energy trading or structural models – monopoly, single buyer,						
wholesale competition, retail competition. Models based on contractual arrangements - pool model, bilateral						
dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Competition for the						
market vs competition in the market, International experience with electricity reform – Latin America, Nordic						
Pool, UK, USA, China and India. California Energy Crisis.						
		Γ	T	_		
Unit	t–V:	No. of Lectures: 09 Ho	urs I	Marks: 12		

**Electricity Markets:** Trading – electricity market places, rules that govern electricity markets, peculiarity of electricity as a commodity, various models of trading arrangements – integrated trading model, wheeling trading model, decentralized trading model. Various electricity markets such as spot, day ahead, forward, future options, reserve, ancillary services market. Market operation, settlement process, Market Clearing Price (MCP), Market power, market efficiency. Spot, dynamic and locational pricing.

### **Text Books:**

- 1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility", CRC Press, 2017.
- 2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Springer Science & Business Media, 2012.

- 1. Sally Hunt, "Making competition work in electricity", John Willey and Sons Inc., 2002.
- 2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2002.
- 3. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", CRC Press, 2nd edition, 2018.

Electric and Hybrid Vehicles (Professional Elective Course – VI)							
			COURSE OUTLIN	Έ			
Course	Electric	and Hybrid Vehicles	5	Short	EHV	Course	
Title:				Title:		Code:	
Course d	escriptior	1:					
This courvehicles.	se introdu The mater	ces the fundamental of rial for this course wi	concepts, principles, ll be prepared in suc	analysis h a mani	and design on and design of the second secon	of hybrid an 11 be useful	d electric for post-
graduate	students, t	eachers, practitioners	and final year under	graduate	students.		
This cou	rse goes o	deeper into the vario	ous aspects of hybr	id and e	electric drive	train such	n as their
configura	tion, types	s of electric machines	that can be used, er	nergy sto	rage devices	, etc. Each	topic will
be develo	ped in log	ical progression with	up-to-date informati	on.		1	
Lecture		Hours/week	No. of weeks	Tota	al hours	Semeste	r credits
		03	14		42	0	3
Prerequi	site cours	e(s):					
Electric N	Aachines a	nd Drives, Power Ele	ectronics				
Course o	bjectives:						
1. Exp	lain the ba	asics of electric and	hybrid electric vehi	icles, the	eir architectu	re, technol	ogies and
func	lamentals.						
2. Exp	lain plug – tronics dev	- in hybrid electric ve	hicle architecture, de	esign and	component	sizing and	the power
3 Ana	lvze vario	us electric drives suit	able for hybrid electr	ic vehicle	es		
4. Disc	uss differe	ent energy storage tec	hnologies used for h	vbrid ele	ctric vehicles	s and their o	control.
5. Den	nonstrate (	different configuration	ons of electric vehic	cles and	its compon	ents. hvbri	d vehicle
conf	iguration	by different techniqu	es. sizing of compo	nents and	l design opti	mization a	nd energy
man	agement	<b>J</b>	8 - I		<i>8</i> 1		
	0						
Course o	utcomes:						
After suc	cessful con	mpletion of this cours	e the student will be	able to:			
1. Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and							
<ol> <li>Analyze the use of different power electronics devices and electrical machines in hybrid Electric vehicles</li> </ol>							
3. Exp	lain the u	use of different ener	gy storage devices	used fo	r hybrid ele	ectric vehic	cles, their
4. Inter	pret work	ing of different config	gurations of electric v	ehicles a	nd its compo	onents, hybr	id vehicle
5 Ano	iguration,	performance analysis	management strates	inent str	in hybrid and	2 V S. Lalactric vo	hicles
5. Analyze the use of different energy management strategies used in hybrid and electric vehicles							

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	COURSE	CONTENT				
Electric and Hybrid Vehicles	Semester:		VIII			
Teaching Scheme:		Examination sc	heme			
Lectures: 3 hour	s/week	End Semester B	Exam (ES	5E):	60 marks	
		Duration of ES	E:		03 hours	
		Internal Session	nal Exam	s (ISE):	40 marks	
Unit–I:	No. of Lectu	res: 08 Hours		Marks: 12	2	
Introduction: Conventional V	ehicles: Basics	of vehicle perfe	ormance,	vehicle po	wer source	
characterization, transmission cha	racteristics, math	ematical models to	o describe	e vehicle perfo	ormance.	
Introduction to Hybrid Electric	Vehicles: Hist	ory of hybrid a	ind electr	ric vehicles,	social and	
environmental importance of hyl	orid and electric	vehicles, impact	of moder	n drive-train	s on energy	
supplies.						
Unit II.	No of Lootu	nose 08 Hound		Monkas 1'	.	
Unit-II: Hybrid Electric Drive-trains: B	asic concept of k	whether the section int	roduction	to various h	2 vbrid drive	
train topologies power flow contr	ol in hybrid drive	-train topologies	fuel effic	iency analysis		
		t train topologies,				
Unit–III:	No. of Lectu	res: 08 Hours		Marks: 12	2	
Electric Trains: Electric Drive-tr	ains: Basic conce	pt of electric tract	ion, introc	duction to var	ious electric	
drive train topologies, power flo	w control in elec	tric drive-train to	pologies,	fuel efficien	cy analysis.	
Electric Propulsion unit: Introdu	ction to electric	components used	d in hybr	id and electr	ric vehicles,	
Configuration and control of DC	Motor drives, C	onfiguration and o	control of	Induction M	lotor drives,	
configuration and control of Per	manent Magnet 1	Motor drives, Co	nfiguratio	on and contro	ol of Switch	
Reluctance Motor drives, drive sy	stem efficiency.					
			T			
Unit–IV:	No. of Lectur	res: 09 Hours		Marks: 12	2	
Energy Storage: Introduction to	Energy Storage R	equirements in Hy	/brid and l	Electric Vehic	cles, Battery	
based energy storage and its anal	ysis, Fuel Cell ba	sed energy storage	e and its a	analysis, Sup	er Capacitor	
based energy storage and its analy	ysis, Flywheel ba	sed energy storage	e and its a	inalysis, Hybi	ridization of	
different energy storage devices.	Sizing the drive sy	stem: Matching th	he electric	c machine and	the internal	
combustion engine (ICE), Sizing t	ne propulsion mo	tor, sizing the pow	ver electro	onics, selectin	g the energy	
storage technology, Communicati	ons, supporting si	ubsystems.				
∐nit_V•	No. of Lectu	res: 09 Hours		Marks 1'	,	
Energy Management Strategies	s. Introduction to	energy managen	nent strate	$\frac{1}{1}$	hybrid and	
electric vehicles classification of different energy management strategies comparison of different						
energy management strategies, implementation issues of energy management strategies.						
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).						
Text Books:						
1. C. Mi, M. A. Masrur, "Hy	/brid Electric Ve	chicles: Principles	and Ap	plications wi	th Practical	
Perspectives", Wiley-Blackw	vell, 2 nd edition, 2					

2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer; 1st edition, 2015.

- 1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd edition, 2011.
- Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 1st edition, 2004.
- 3. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 1st edition, 2008.
- 4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 1st edition, 2016.

	Advanced Electric Drives (Professional Elective Course – VI)										
				(COURSE	OUTLIN	Е				
Course	Advance	d Electr	Electric Drives Short AED Course								
Title:							Title:			Code:	
Course d	lescription	1:									
Lecture		Hours/weekNo. of weeksTotal hoursSemester credits									
			03		1	4		42		()3
Prerequi	site course	e(s):									
Electrical	Machines	, Control	l Syste	ems, Po	ower Elect	ronics					
Course o	bjectives:		-								
Electrical	drives pl	lay an i	mport	ant pa	rt as elect	romechan	ical ener	gy con	verter	s in trans	sportation,
materials	handling a	and most	adva	nced pi	roduction	processes.	The cou	rse tries	to giv	ve unified	treatment
of compl	ete electric	cal drive	syste	ms, ind	cluding th	e mechani	cal parts	, electri	cal m	achines, a	and power
converter	s and contr	rol.			-		_				_
Course o	utcomes:										
After suc	cessful cor	npletion	of this	s cours	e the stude	ent will be	able to:				
1. To ac	quire the k	nowledg	ge of s	electio	n of drives	as per pra	actical op	erationa	al indu	strial requ	airement.
2. To a	pply their	knowled	lge to	prepa	re control	schemes	as per d	ifferent	types	of motor	rs used in
indus	tries.		-				-				
3. To es	timate & s	olve har	monic	and po	ower factor	r related p	roblems i	n contro	olling	AC and D	OC drives.
4. To ac	quire know	vledge of	f vario	ous con	trol techni	ques used	in electo	ral driv	es.		
5. To st	udy the pra	actical us	e of d	rives a	nd its cont	rol for diff	erent app	olication	ıs.		
				(COURSE	CONTEN	T				
Advance	d Electric	Drives				Semester	r:		VII		
Teaching	g Scheme:					Examina	ation sch	eme			
Lectures	:	3	hours	/week		End Sen	nester Ex	xam (ES	SE):		50 marks
						Duratio	of ESF)3 hours
						Internal	Session	al Exan	ns (ISI	F.)•	10 marks
	Unit I	•		No	of Lootu				13 (151 M	orles 12	FO IIIdi KS
UIIII-1: NO. OI LECTURES: 08 HOURS MarKs: 12											
model of machine with armature voltage control only and converters with continuous conduction only											
Closed loop control using single (speed) and two loops (speed current). Implementation using circulating											
current type three phase dual converter and four quadrant transistorized chopper. State feedback control											
and sliding mode control of excited DC machine in field, excited DC machine. Modeling and control of											
and sliding mode control of excited DU machine in field-excited DU machine, Modeling and control of											
separatel	y-separate	iy weake	ening i	region	and discoi	ninuous co	onverter	conduct	ion m	ode, Con	TOI OF DC
series ma	cnine.				0T	60 T	<u> </u>			1 10	
	Unit–II	:		No	. of Lectu	res: 08 Ho	ours		Μ	arks: 12	

Open-loop Dynamic Performance of AC & DC Drives: Starting & reversal time, Energy consumption & energy savings principle. Drives Application Engineering for Fan, Pump, Compressor, Lift-Elevator, Kiln, Winder-Un-Winder, Traction application. Synchronization and master-slave configuration.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12					
AC Drives and its Operational S	Strategies: Variable frequency open	ration of three phase symmetrical-					
induction machine, Scalar control methods for constant power an constant torque modes, Vector control							
of induction machine, Method	s of field sensing and estimat	ion, Field orientation methods:					
Implementation of IRFO scheme	using current controlled PWM, V	/SI and implementation of DSFO					
scheme using CSI, Performance o	f vector controlled permanent magn	net machine.					
Unit–IV:	No. of Lectures: 09 Hours	Marks: 12					
Control and Estimation of AC D	Prives: Introduction to speed control	l of Switched Reluctance Machine,					
Induction motor drive, basic of S	calar & Vector control V/f Contro	l, Sensorless vector control, Field					
Oriented Control, Direct torque c	ontrol and flux observation, Speed	control of wound rotor induction					
motors: Converter based static ro	otor resistance control, Static scher	bius drive using line commutated					
converter cascade, Analysis and	estimation of harmonics and powe	r factor, Vector control of wound					
rotor induction machine using se	lf-commutated converter cascade a	and improvement in power factor,					
Variable speed constant frequency	(VSCF) generation.						
Unit–V:	No. of Lectures: 09 Hours	Marks: 12					
Control of Permanent Magnet	Machine & Compatibility to Mo	tor & Drives: Power Electronics					
Control of Permanent magnet syne	chronous machine, Brushless DC m	achine, Surface permanent magnet					
machine and interior, Effects of d	rives on motor - dV/dt, THD, Com	mon Mode Voltage, Shaft Voltage					
and Bearing Current, Sound & Vi	bration Laboratory Work: Closed lo	pop current-speed control of AC &					
variable-DC drives, Variable volt	age frequency control, Vector control	rol mechanism, Position control of					
stepper motor.							
Text Books:							
1. P. C. Krause, O. Wasynczu	k, S. D. Sudoff, "Analysis of Elect	ric Machinery and Drive System",					
John Wiley and Sons, 2013.							
2. B.K. Bose, "Modern Power	Electronics and Electric Drives", P	earson Education, Asia, 2003.					
3. B.N. Sarkar, "Fundamental	of Industrial Drives", Prentice Hall	of India Ltd.					
Reference Books:							
1. M. Chilkin, "Electric Drives	s", Mir Publishers, Moscow.						
2. Mohammed A. El-Sharkay	wi, "Fundamentals of Electric Di	rives", Thomson Asia, Pvt. Ltd.					
Singapore.							
3. N.K. De and Prashant K. Se	en, "Electric Drives", Prentice Hall	of India Ltd.					
4. V. Subrahmanyam, "Electri	c Drives: Concepts and Application	ns", Tata McGraw Hill.					

	EH	V AC Transn	nission	Systems (Professio	nal Elect	tive Cours	e – VI)	
				COURSE	OUTLIN	Έ	1		
Course	EHV AC	C Transmissio	on Syste	ems		Short	EHVAC	Course	
Title:						Title:		Code:	
Course d	escription	1:							
This cour	se introdu	ces the conce	pts of e	extra high	voltage A	C transi	nission. It	also empha	sis on the
behavior	of the lin	e parameters	for ext	ra high vo	oltages, vo	oltage gr	adients of	the transmi	ssion line
conductor	rs gradient	s, the effect of	corona	, electro st	atic field o	calculatio	ons, voltage	e control wh	en the line
carries ex	tra high vo	oltages.						G	
Lecture		Hours/we	eek	No. of	weeks	Tot	al hours	Semest	er credits
		03		1	4		42		03
Prerequi	site cours	e(s):							
Power Sy	stem-I, Po	wer System-II	[
Course o	bjectives:								
The need	for energy	is very urgen	it in the	e developir	ng countrie	es, and na	ational poli	cies and the	ir relation
to other c	ountries ar	e sometimes b	based or	n energy re	quirement	s, chiefly	/ nuclear, h	ydro-electri	c and coal
or oil-fire	ed stations	s are located	very fa	ar from lo	ad centers	s for vai	nous reaso	ns which r	equire the
transmiss	ion of the	generated elec	tric pov	wer over v	ery long d	istances.	This requi	res very hig	h voltages
for transf	nission. I	ne very rapid	strides	taken by	developn	nent of I	JC transmi	ission since	1950 are
transmiss	ion	e ili extra-ioliş	g-uistai		1881011, COI	Inplemen	ung or sup	opiementing	ENV AC
	1011.								
Course o	utcomes:								
After suc	cessful con	npletion of thi	is cours	e the stude	ent will be	able to:			
1. To r	inderstand	the need of El	HV Tra	nsmission	system.	uoie to:			
2. To c	alculate li	ne and ground	parame	eters.	sjotenn				
3. To c	lescribe the	e impact of high	gh volta	ige level o	n the envii	ronment.			
4. To t	inderstand	Electrostatic a	and Ma	gnetic field	ds of EHV	lines.			
5. Tou	inderstand	corona and its	s effect	on EHV T	ransmissio	on systen	n.		
COURSE CONTENT									
EHV AC	Transmi	ssion Systems	5		Semeste	r:	V	III	
Teaching	Scheme:				Examina	ation sch	eme		
Lectures		3 hours	s/week		End Sen	nester E	xam (ESE)):	60 marks
					Duration	n of ESE	2.		03 hours
					Internal	Session	al Exams (ISE):	40 marks
	Unit–I	•	No	. of Lectu	res: 08 Ho	ours		Marks: 12	
		-	1.0						

Introduction, Transmission Line Trends and Preliminaries: Basic aspects of AC Power Transmission, Need for EHV transmission lines, Role of EHV AC Transmission, Power handling capacity and line loss, Examples on giant power pools and number of lines, Cost of Transmission lines and equipment, Mechanical considerations in line performance- types of vibrations and oscillations.

Unit–II:No. of Lectures: 08 HoursMarks: 12Calculation of line and Ground parameters: Resistance of conductors, Temperature rise of
conductors and current carrying capacity, Properties of bundled conductors, Inductance of EHV line
configurations, line capacitance calculations, sequence inductance and capacitances.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12
Voltage gradient of conductors:	Electrostatic, Field of a point charg	ge and its properties, Field of sphere
gap, Field of line charges and th	eir properties, charge potential	relations for multi-conductor lines,
Maximum charge condition on	a three phase line. Surface volta	age gradient on conductors-single
conductor, two conductors bundle	e, Maximum surface voltage grad	lient, Mangoldt formula, design of
cylindrical cages for corona gradie	ents	

Unit–IV:	No. of Lectures: 09 Hours	Marks: 12
Electrostatic and Magnetic field	s of EHV lines: Electric shock and	threshold currents, Effects of high

electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level. Electrostatic field of a double circuit 3 phase AC line, Insulated ground wire and induced voltage in insulated ground wires.

Magnetic field calculation of horizontal configuration of single circuit of three phase lines, Effects of power frequency magnetic fields on human health.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12

Corona and its effects: Corona formation, visual critical voltage, corona power loss, corona loss formulae, charge-voltage diagram, increase in effective radius of conductor and coupling factors, attenuation of travelling waves due to corona loss. Audible noise – generation and characteristics, limits for audible noise, AN measurement and meters- microphones, weighting networks.

Text Books:

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International Publishers, Third Edition, 2007.

- 1. A. Chakrabarti, D.P. Kothari, A.K. Mukhopadhyay, "Performance Operation and Control of EHV Power Transmission Systems", Wheeler Publishing, 1999.
- 2. S. Rao, "EHV-AC, HVDC Transmission and Distribution Engineering", Khanna Publishers, Third Edition, 2017.
- 3. <u>http://nptel.iitm.ac.in</u>

	Illumination Engineering (Professional Elective Course – VI)							
Commo	[COURSE	OUTLIN	E		Commo	
Course Title:	Illumina	tion Engineering			Snort Title:	IE	Course Code:	
Course d	escription	:			Thee.		couc.	
The explo	The explores the knowledge of types of illumination, lighting systems, lighting Scheme, measurement							
of might,	laws of illu	imination, design of l	Interior Lig	hting, Indi	ian standa	ard recom	mendation a	nd standard
practices	for illumin	nation levels in varie	ous areas,	design of	outdoor	lighting	and special	features of
aesthetic	lighting .							
			1					
Lecture	Lecture Hours/week No. of weeks Total hours Semester credits							ter credits
		03	1	4	42 03			03
Prerequi	site course	e(s):						
Course o	bjectives:							
To provid	le an intro	duction to the fundat	mentals of	illuminatio	on engine	ering and	l architectur	al lighting
design. I	o impart l	ignting fundamentals	s, measure	ment, and	technolo	gy and the	neir applicat	ion in the
analysis a	or illumin	of architectural light	ing systems	s. Factors	to be con	sidering v	vnne design	ing indoor
		ation schemes.						
Course o	utcomes:							
After suc	cessful con	npletion of this cours	se the stude	nt will be	able to:			
1. Appl	y basic eng	gineering to understan	nd concept	of lighting	g system,	selection	of lighting f	actors
effect	ting on ligh	nting scheme.						
2. Ident	ify the crite	eria for the selection	of lamps, n	neasureme	nt of ligh	nt and law	of illuminat	tions. and
lighti	ng systems	for an indoor or out	door space	•				
3. Desig	gn and Eva	luate different types	of lighting	scheme de	signs for	indoor lig	ghting and s	election of
luminary to meet the specified needs with appropriate consideration.								
4. Perform calculations on photometric performance of light sources and luminaries for outdoor								
purposes. 5 Decien special lighting scheme to most the specified needs with empropriate consideration in								
5. Design special lighting scheme to meet the specified needs with appropriate consideration in monument Sports and aviation lighting								
Illumination Engineering								
COURSE CONTENT								
Illumination Engineering Semester: VIII								
Teaching	g Scheme:			Examina	ation sch	eme		
Lectures	•	3 hours/week		End Sen	nester Ex	am (ESE	Z):	60 marks
L		I					I	

		Duration of ESE:03 hours						
		Internal Session	40 marks					
Unit–I:	Unit–I: No. of Lectures: 09 Hours Marks: 12							
Introduction of Light: Radiati	on, colour and	eye vision. Type	s of illumination, D	ay lighting,				
Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the								
lighting-shadow, glare, reflection, Colour rendering and stroboscopic effect, Methods of artificial								
lighting, Lighting systems-direct,	indirect, semi d	irect, semi indired	ct, Lighting scheme, (General and				
localized								
Unit–II:	No. of Lectur	res: 09 Hours	Marks: 1	2				
Light Source and measurement	t light: Incandeso	ent, electric discl	harge, fluorescent and	LED light,				
Luminaries and control circuits. D	Definition of lumin	ous flux, Luminou	is intensity, Lumen, Ca	undle power,				
Illumination, M.H.C.P, M.S.C.P,	, M.H.S.C.P, Lai	np efficiency, Bi	rightness or luminanc	e, Laws of				
illumination, Inverse square law an	nd Lambert's Cos	ine law, Illuminat	ion at horizontal and v	ertical plane				
from point source, Concept of pol	lar curve, Calcula	tion of luminance	and illumination in ca	ase of linear				
source, round source and flat sour	ce							
	P		r					
Unit–III:	No. of Lectur	res: 08 Hours	Marks: 1	2				
Design of Interior Lighting: 1	Definitions of m	aintenance factor	, Uniformity ratio, I	Direct ratio,				
Coefficients of utilization and factor	tors affecting it, I	llumination requir	ed for various work pl	anes, Space				
to mounting height ratio, Types of	f fixtures and relat	tive terms used for	r interior illumination,	Calculation				
of wattage of each lamp and no o	of lamps needed,	Layout of lamp lu	uminaries, Calculation	of space to				
mounting height ratio, Indian stan	dard recommenda	tion and standard	practices for illuminat	ion levels in				
various areas, Special feature for e	entrance, staircase	, Corridor lighting	g and industrial buildin	lg.				
Unit-IV:	No. of Lectur	res: 08 Hours	Marks: 1	2				
Design of Outdoor Lighting: Str	reet Lighting : Typ	pes of street and the	heir level of illuminati	on required,				
Terms related to street and street I	ighting, Types of	fixtures used and	their suitable application	ion, Various				
arrangements in street lighting, Re	equirements of go	od street lighting,	Selection of lamp and	luminaries,				
Calculation of their wattage, Nun	nber and arrangen	nent, Calculation	of space to mounting	height ratio,				
Calculation of illumination level a	available on road	.Flood Lighting T	ypes of fixtures and the	neir suitable				
applications, Selection of lamp	and projector, C	alculation of thei	r wattage and numbe	er and their				
arrangement, Calculation of space	to mounting heig	ht ratio.						
				•				
Unit-V:No. of Lectures: 08 HoursMarks: 12								
Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Auditorium								
lighting and aviation and transport lighting. Lighting for displays and signaling- neon sign, LED LCD								
displays and lighting for surveillance.								
Text Books:		<u></u>		and 11.1				
I. Gupta J. B., "Utilization of	Electric Power &	Electric Traction"	S. K. Kataria & Sons	, 2 nd edition,				
	11 IZI D 1	D 11: (* 12th	1.4 1000					
2. Uppal S. L, "Electrical Power", Khanna Book Publication, 13 th edition, 1988.								

3. Partab H. P., "Art & Science of Utilization of Electrical Engineering", Dhanpat Rai Publications, 2017.

- 1. Jack L. Lindsey, "Applied Illumination Engineering", Fairmont Pr; 2nd edition, 1996.
- 2. John Matthews, "Introduction to the Design and Analysis of Building Electrical Systems", Springer Science & Business Media, 1993.
- 3. M.A. Cayless, "Lamps and Lighting", Routledge; 4th edition, 2012.
- 4. O. E. Taylor, "Utilization of Electrical Energy", Longman, 1971.
- 5. H. S. Mamak, "Book on Lighting", Publisher International lighting Academy
- 6. Joseph B. Murdoch, "Illumination Engineering from Edison's Lamp to Lasers" Publisher York, PA: Visions Communications, 1994.

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon (M.S.)

	Digital Signal Processing (Open Elective Course – IV)							
			COUDSE		Г			
Course	Digital S	ignal Duagage	COURSE	UUILIN	E Showt	DCD	Course	
Titler	Digital S	ignal Process	ing		Short Title:	DSP	Code	
Course d	ocorrintion				The.		Coue.	
Digital Si	anal Proce	L.	concorned with	the repres	ontation	transformat	ion and m	anipulation
of signals		uputer After h	alf a contury adv	ances DS	D has be	come an im	ortant fie	amputation
nenetrate	d a wide r	ange of applic	ation systems su	ch as cons	umer ele	otropics dia	ital comm	unications
medical i	maging no	ower application	ons and so on Wi	ith the drai	matic inc	rease of the	processing	σ canability
of signal	processing	it is the expect	station that the im	portance a	nd role of	DSP is to a	ccelerate a	and expand.
Lecture	<u>, , , , , , , , , , , , , , , , , , , </u>	Hours/we	ek No. of	weeks	Tota	al hours	Semest	ter credits
Letter		03	1	4	100	42		
Proroqui	site cours		-	•		72		05
Trerequi		e(s).						
Course o	hiectives							
The object	tive of this	s course is to r	rovide an underst	tanding of	Digital S	ignal Proces	sing Ton	ics include:
Introduct	ion to digit	tal signal proc	essing and applic	ation disc	rete time	signals and	svstems.	Analysis of
LTI syste	ms. Struct	ures of discret	e time systems [.] F	ilter desig	ning tech	niques: DFT	and FFT	r mary 515 Of
	ins, struct				ing teen	inques, 211		
Course o	utcomes:							
After suc	cessful cor	npletion of thi	s course the stude	ent will be	able to:			
1. A	nalyze Di	screte Time sy	stems with Discre	ete Fourier	Transfo	m		
2. E	Design digi	tal filters IIR a	and FIR filters					
3. A	analyze fin	ite word lengtl	h effects in signal	processin	g			
4. E	Design filte	rs using						
5. L	Inderstand	Digital Signal	Controllers and	their Appli	ications			
			COURSE	CONTEN	T			
Digital S	ignal Proc	essing		Semeste	r:	VI	II	
Teaching	Scheme:			Examina	ation sch	eme		
Lectures	•	3 hours	s/week	End Sen	nester Ex	am (ESE):		60 marks
				Duration	n of ESE	:		03 hours
				Internal	Sessiona	l Exams (IS	SE):	40 marks
Unit–I: No. of Lectures: 08 Hours Marks: 12								
Discrete-Time Signals and Systems: Sequences, discrete time systems, LTI systems, frequency domain								
representation of discrete time signals and systems, discrete time signals and frequency domain								
represent	ation, Four	rier Transform	. Implementation	of discret	e time sy	stems: Strue	cture for H	FIR system,
Structure	for IIR sys	stems.						
			ſ		1			
	Unit-II:No. of Lectures: 09 HoursMarks: 1)				

Sampling of Continuous Time Signals: Sampling and reconstruction of signals, frequency domain representation of sampling, discrete time processing of continuous time signals, continuous time processing of discrete time signals, changing the sampling rate using discrete time processing, multi rate signal processing, digital processing of analog signals, over sampling and noise shaping in A/D and D/A conversion.

Unit–III:	No. of Lectures: 08 Hours	Marks: 12

Transform Analysis of LTI Systems: Frequency response of LTI systems, system functions, frequency response for rational system functions, magnitude-phase relationship, all pass systems, minimum phase systems, and linear systems with generalized linear phase Discrete Fourier Transform: Discrete Fourier Transform, properties, linear convolution and circular convolution.

Unit–IV:	No. of Lectures: 08 Hours	Marks: 12
Filter Design Techniques: Design	n of IIR filters using Impulse Invari	ant Response method and Bilinear

Transformation method. Butterworth filters and chebyshev Filter's response, Design of FIR filters by windowing, Kaiser Window method, optimum approximations of FIR filters.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Efficient computation of the DF	T: FFT algorithms- decimation in	time and decimation in frequency,
Goertzel algorithm, Implementation	on of the DFT using convolution, I	Introduction to wavelet transform:

Wavelet comparison with Fourier transforms, Applications of Wavelet cosine transform, Discrete cosine transform (DCT), Block Diagram and features of DSP processors from Texas Instrument i.e TMS320C2812.

Text Books:

- 1. S. Salivahanan, "Digital Signal Processing", McGraw Hill Education; 3rd edition, 2017.
- P. Ramesh Babu, "Digital Signal Processing", Scitech Publications (India) Pvt. Ltd., 6th edition, 2014.
- Oppenheim A.V., Schafer, Ronald W. & Buck, John R, "Discrete Time Signal processing", Pearson Education, 2nd edition, 1999.
- 4. Proakis, J.G., Manolakis, D.G., "Digital Signal Processing: Principles Algorithms and Applications", Pearson Education India; 4th edition, 2007.

- 1. Rabiner, L.R., Gold B., "Theory and applications of DSP", Prentice Hall of India, 2016.
- Oppenheim, Alan V., Willsky, Alan S., "Signals and Systems", Prentice Hall of India, 2nd Edition, 2015.
- 3. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, 1st edition, 2015.

	Embedded System (Open Elective Course – IV)								
				COURSE	OUTLIN	E	1		
Course	Embedd	ed System				Short	ES	Course	
Title:						Title:		Code:	
Course d	escription	1:							
The cours	se explores	s knowledge o	of embe	dded syste	em fundan	nentals a	nd its desig	gn aspects.	The course
comprise	s of basic	understanding	g of en	bedded sy	stem cond	cepts, ro	le, charac	teristics an	d real time
Implemen	itation in v	arious applica	tion wi	th real tim	e operating	g system	concepts e	tc.	
Lecture		Hours/we	eek	No. of	weeks	Tota	al hours	Semes	ter credits
		03		1	4		42		03
Prerequi	site cours	e(s):							
~									
Course o	bjectives:								
Students	have know	ledge about tl	ne basic	tunctions	, structure	, concept	, applicatio	on and deve	elopment of
embedded	1 systems a	and enable the	learner	to design	a system w	ith comb	onation of 1	hardware a	nd software
for a spec	ific real th	me application	1.						
Course o	utcomes								
After suc	cessful cor	nnletion of thi	s cours	e the stude	ont will be	able to:			
1 Ahle	to unders	tand the role a	ind con	cent of em	hedded sv	stems			
2. Able	to unders	tand the role a	sion in	processor.	pipelines.	memory	architectu	re.	
3. Und	erstand the	e concepts of A	ARM in	terfacing i	n advance	d embed	led system		
4. Able	to identif	y communicat	e and in	nterface en	nbedded no	etwork p	rotocol		
5. Den	onstrate th	ne use of open	source	RTOS and	d embedde	d system	application	n, design is	sues for
the s	ame.								
Eh.d.l	10		(JUURSE	CONTEN	1			
Embedde	a System				Semester	r:	V	111	
Teaching	Scheme:				Examina	ation sch	eme		
Lectures		3 hour	s/week		End Sen	nester Ex	am (ESE)	:	60 marks
					Duration	n of ESE	:		03 hours
				Internal	Sessiona	al Exams (ISE):	40 marks	
Unit–I: No. of Lectures: 09 Hours Marks: 12									
Introduction to Embedded Systems: Introduction to embedded systems, history, design challenges -									
optimizing design metrics, time to market concept, top-down design process and technology, applications									
of embedded systems and recent trends in embedded systems, processor technology, IC technology and									
design technology, trade-offs in embedded systems. Custom Single-Purpose Processor Design: Design									
of genera	l purpose p	processor: con	troller a	and data pa	th design.				
					a a -	1			
	Unit-II		No	. of Lectu	res: 08 Ho	ours		Marks: 12	2

System Architecture: Introduction to Advance Reduced Instruction Set Computer (RISC) Machine (ARM) embedded systems - RISC versus Complex instruction set computer (CISC) machines, ARM design philosophy, ARM processor fundamentals, ARM extension family, operating modes, pipeline, memory management, bus architecture, exception handling and interrupt structure. Brief introduction to ARM-7 processor LPC2148 block diagram.

Unit-III:	No. of Lectures: 08 Hours	Marks: 12

LPC 2148 Interfacing and Programming: need of interfacing, interfacing techniques, basic embedded C programs for GPIO and interfacing of different devices like switches, keypad, Light Emitting Diode (LED), Liquid Crystal Display (LCD), Relay, Stepper Motor. Study and programming of on-chip peripherals like timers, counters, on-chip Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Universal Asynchronous Receiver/Transmitter (UART), Real Time Clock (RTC) modules, Watch Dog Timer (WDT), phase locked loop (PLL), Pulse Width Modulator (PWM).

Unit–IV:No. of Lectures: 08 HoursMarks: 12Communication Protocol: Basic protocol concept, study of protocols like Serial Peripheral Interface
(SPI), Inter-Integrated Circuits (I2C), Controller Area Network (CAN), Ethernet. Wireless Protocols:
Infrared Data Association (IrDA), Bluetooth, IEEE802.11 (Wi-Fi), ZigBee, RF modules, etc. Case study
of Complementary Metal Oxide Semiconductor (CMOS) camera (without codes), requirement
specification, different ways to design of camera.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12				
Real Time Operating System ((RTOS) Concept: Need of RTOS	S in embedded system software,				
foreground/background systems, n	nultitasking, context switching, IP	C, scheduler policies, architecture				
of kernel, task scheduler, ISR, semaphores, mailbox, message queues, pipes, events, timers, memory						
management, RTOS services in contrast with traditional OS. Introduction to µC/OS-II RTOS, study of						
kernel structure of µC/OS-II, synchronization in µCOS-II, inter-task communication in µC/OS-II,						
memory management in $\mu C/OS$ -I	I, porting of RTOS of ARM 2148	, Application developments using				
μC/OS-II.						

Text Books:

- 1. Raj Kamal, "Embedded Systems", McGraw Hill Education (India) Private Limited, Third edition, 2017.
- 2. Dr.K.V.K.K. Prasad, "Embedded/Real Time Systems Programming Black Book", Dreamtech Press, New edition, 2003.
- 3. Frank Vahid, Tony Givargis, "Embedded Systems Design: A Unified Hardware/Software Introduction", John & Wiley Publications, 2002.

- 1. Andrew Sloss, "ARM System Developer guide", Elsevier India; First edition, 2004.
- 2. Data sheet and User manual of LPC2148.
- 3. Steve Furber, "ARM System-on-Chip Architecture", Pearson, Second edition, 2014.
- 4. Jean J.Labrose, "Micro C / OS-II", Indian Low Price Edition, second edition, 2002.

5. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C", Second Edition, 2007.

COURSE OUTLINE Course Title: Short Title: ROB Course Code: Course Code: Course description: Title: Code: Code: In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Hours/week No. of weeks Total hours Semester credits Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s):	Robotics (Open Elective Course – IV)							
Course objectives: Short Title: ROB Course Code: In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Total hours Semester credits In this course, students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Interval to the top of the top								
Course Title: Rob Course Code: Course description: Title: Code: In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives:			COURSE	OUTLIN	E	r	1	
Title: Code: Course description: In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: I To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3 1 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. 7 03 1 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 3. 5 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 <td>Course Robotics</td> <td></td> <td></td> <td></td> <td>Short</td> <td>ROB</td> <td>Course</td> <td>;</td>	Course Robotics				Short	ROB	Course	;
Course description: In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. 3. To understand and learn robotic transformations. 4. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. 2. Define role of actuators, sensors and vision system in robotics 3. 3. Describe various transformations in robots. 4. 4. Analyze the different kinematics and dynamics in robotics 5. 5. Apply control techniques for programming in robotics	Title:				Title:		Code:	
In this course, students take on the roles of mechanical engineers, computer scientists and electrical engineers. Students research dynamics, kinematics and sensors. Topics such as such as motion planning and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand structures and classifications in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics 5. Apply control techniques for programming in robotics COURSE CONTENT <td colspan="7">Course description:</td>	Course description:							
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and obstacle avoidance, velocity and acceleration, serial chain mechanisms, pneumatic actuators, and drive circuits are covered. Lecture Hours/week No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 3. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robotics 5. Apply control techniques for programming in robotics 5. Apply contro	engineers. Students resear	ch dynamics, k	inematics a	and sensors	s. Topics	such as	such as moti	on planning
Interview No. of weeks Total hours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: Semester credits 1. To understand structures and classifications in robotics 2. 7 2. To gain knowledge of types of actuators and sensors in robotics. 3. 7 3. To understand and learn robotic transformations. 4. 7 4. To know different analysis techniques for robotic kinematics and dynamics. 5. 5. 5. To learn control techniques for robotic programming. Course outcomes: Course outcomes: After successful completion of this course the student will be able to: 1. 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. 5. Apply control techniques for programming in robotics 5. Semester: VIII Teaching Scheme: Examination Scheme VIII	and obstacle avoidance, v	velocity and acc	celeration,	serial chai	in mecha	unisms, j	pneumatic ac	tuators, and
Lecture Hours/week No. of weeks Total nours Semester credits 03 14 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. 3. To understand and learn robotic transformations. 4. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. 5. To learn control techniques for robotic programming.	drive circuits are covered.		NT C		T 4	11	0	4 1.4
03 14 42 03 Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics Semester: VIII	Lecture H	lours/week	No. of	weeks	Tota	al hours	Semes	ter credits
Prerequisite course(s): Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics Semester: VIII		03	1	4		42		03
Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robotics 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics VIII	Prerequisite course(s):							
Course objectives: 1. To understand structures and classifications in robotics 2. To gain knowledge of types of actuators and sensors in robotics. 3. To understand and learn robotic transformations. 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics Semester: VIII								
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 4. To know different analysis techniques for robotic kinematics and dynamics. 5. To learn control techniques for robotic programming. Course outcomes: After successful completion of this course the student will be able to: 1. Explain structure and classification of robots. 2. Define role of actuators, sensors and vision system in robotics 3. Describe various transformations in robots. 4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics Semester: VIII Teaching Scheme: 	3. To understand and lea	rn robotic trans	stormation	S.			_	
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4. Analyze the different kinematics and dynamics in robots. 5. Apply control techniques for programming in robotics COURSE CONTENT Robotics VIII Examination Scheme	 Describe various trans 	sformations in r	obots.					
5. Apply control techniques for programming in robotics COURSE CONTENT Robotics Semester: VIII Teaching Scheme: Examination Scheme	4. Analyze the different	kinematics and	dynamics	in robots.				
Image: Contract of the second seco	5. Apply control techniq	ues for program	nming in r	obotics				
COURSE CONTENT Robotics Semester: VIII Teaching Scheme: Examination Scheme VIII								
RoboticsSemester:VIIITeaching Scheme:Examination Scheme	COURSE CONTENT							
Teaching Scheme: Examination Scheme	Robotics			Semester	•		VI	II
	Teaching Scheme: Examination Scheme							
Lectures:3 hours/weekEnd Semester Exam (ESE):60 marks	Lectures:	3 hours/week		End Sem	ester Ex	am (ES	5E):	60 marks
Duration of ESE: 03 hours				Duration	of ESE	:		03 hours
Internal Sessional Exam (ISE): 40 marks		Internal Sessional Exam (ISE): 40 mar			40 marks			
Unit–I: No. of Lectures: 09 Hours Marks: 12								
Introduction to Robotics: Robots, History of Robots, Robots, Usage, Basic Structure of Robots,	Introduction to Robotic	es: Robots, Hi	story of R	Robots, Ro	bots Us	age, Ba	sic Structure	of Robots,
Classification of Robots by Applications, classification by Coordinate Systems, Classification by	Classification of Robots	by Applicatio	ns, classif	ication by	Coordi	nate Sy	stems, Classi	ification by
Actuation System, Classification by Control System, Robot classification by programming method.	Actuation System, Classif	fication by Cont	trol Systen	n, Robot cl	assificati	on by p	rogramming 1	nethod.
Unit–II:	No. of Lectures: 08 Hours	Marks: 12						
---	--	--	--	--	--	--	--	
Robot Actuators, Sensors and	Vision: Robot Actuators: Pneuma	tic, Hydraulic and Electric Robot						
Sensors: Sensor classification, Internal Sensors, External Sensors, Sensor selection Vision System in								
Robots.								
Unit–III:	No. of Lectures: 09 Hours	Marks: 12						
Transformations and Statics	in Robotics: Robot Architecture,	Pose of Rigid Body, Coordinate						
Transformation, Denavit and Ha	artenberg (DH) Parameters, Forces	and Moment balance, Recursive						
Calculations, Equivalent Joint To	rque, Role of Jocobian in Statics.							
Unit–IV:	No. of Lectures: 08 Hours	Marks: 12						
Kinematics and Dynamics: For	ward Position Analysis, Inverse Pos	sition Analysis, Velocity Analysis,						
Inerita Properties, Eular-Lagrang	e Formulation, Newton – Eular Forn	nulation, Recursive Newton – Eular						
Algorithm								
	1	1						
Unit–V:	No. of Lectures: 08 Hours	Marks: 12						
Robotic Control and Program	Robotic Control and Programming: Control Techniques, Second Order Linear Systems, Feedback							
Control and its Performance, No	n Linear Trajectory Control, State S	Space Representation and Control,						
Stability, Cartesian and Force Co	ntrols, Robotic Programming							
Text Books:		Y 1 51						
1. Saha S.K., "Introduction to R	Cobotics, 2 nd Edition, McGraw-Hill I	Higher Education, New						
Delhi, 2014.								
Reference Books:		A 1' ' ' N MY'I and I''						
1. Niku Saeed B., "Introductio	n to Robotics: Analysis, Systems,	Applications", Wiley; 2 nd edition,						
2011.	1 dia and Canton 12 Tata McCarro	11:11 2002						
2. Mittal R.K., Nagrath I.J., "Ro	Automation", Khanna Dublishing U	Hill, 2003.						
5. Mukherjee S., Robolics and	Automation, Khanna Publishing H	louse, Delli.						
4. Chaig, J.J., Introduction to K	tobolies. Mechanics and Control, P	earson, New Denn, 5 edition,						
5 Mark W Spong Sath Hutchi	nson and M. Vidvasagar "Pohot M	Indelling and Control" John						
Wiley and Sons Inc. 2005	nson, and wi. vidyasagai, Robot Iv							
6 Steve Heath "Embedded Sys	tem Design" 2nd Edition Newnes	Burlington 2003						
o. Steve Heath, Elliberded Sys	tem Design , 2nd Euton, rewiles,	Durington, 2005.						

	Cyber Security (Open Elective Course – IV)					
Course Cyber See		COURSE	UUILINE Sh		Course	. [
Title:	curity		5110		Course	
1100.			110	с.	Coue.	
Course description:						
Cyber Security court	se focuses on	cyber threats a	and cyber secu	rity that p	rovides the m	uch needed
awareness in the time	es of growing cy	ybercrime episo	des.			
Lecture	Hours/week	x No. of	weeks	Fotal hour	s Semes	ter credits
	03	1	4	42		03
Prerequisite course((s):	I			I	
Course objectives:						
1. To understand	Cybercrime and	d Cyber offense	s.			
2. To understand	Cybercrime three	ough portable d	levices.			
3. To understand	tools and metho	ods used in Cyb	ercrime.			
4. To understand	Phishing and Id	lentity theft.				
5. To understand	Computer Fore	nsics.				
Course outcomes:						
After successful com	pletion of this c	course the stude	nt will be able	.0:		
1. Determine the a	act of Cyber off	fenses.				
2. Determine the	Cybercrime three	ough portable d	evices.			
3. Determine the	methods used in	n Cybercrime.				
4. Determine Phis	shing and Identi	ity theft.				
5. Describe Comp	outer Forensics.					
		COURSE	CONTENT			
Cyber Security			Semester:		VIII	
Teaching Scheme:			Examination	scheme:		
Lectures:	3 hours/w	veek	End Semester Exam (ESE):60 marks			60 marks
	Duration of ESE: 03 hours			03 hours		
			Internal Sess	ional Exai	n (ISE):	40 marks
Unit–I:		No. of Lectur	res: 08 Hours		Marks: 12	2
Introduction to Cy	vbercrime: In	troduction, C	ybercrime: De	finition ar	d Origins of	the Word,
Cybercrime and Infor	rmation Security	y, Who are Cyb	ercriminals?, O	Classificati	ons of Cybercr	imes.

Cyber offenses: How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

Unit–II:	No. of Lectures: 08 Hours	Marks: 12				
Cybercrime: Mobile and Wire	eless Devices: Introduction, Prolif	feration of Mobile and Wireless				
Devices, Trends in Mobility, Cre	edit Card Frauds in Mobile and V	Wireless Computing Era, Security				
Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service						
Security, Attacks on Mobile/Cell	Phones, Mobile Devices: Securit	ty Implications for Organizations,				
Organizational Measures for Hand	dling Mobile device related securi	ty issues, Organizational Security				
Policies and Measures in Mobile C	Computing Era, Laptops					

Unit–III:	No. of Lectures: 08 Hours	Marks: 12	
Tools and Methods Used in Cy	bercrime: Introduction, Proxy Ser	vers and Anonymizers, Phishing,	
Password Cracking, Keyloggers	and Spywares, Virus and Worms	, Trojan Horses and Backdoors,	
Steganography, DoS and DDoS At	tacks, SQL Injection, Buffer Overfl	ow, Attacks on Wireless Networks	

Unit-IV:	No. of Lectures: 09 Hours	Marks: 12

Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft)Understanding Computer Forensics: Introduction, Historical Background of Cyberforensics, DigitalForensics Science, The Need for Computer Forensics, Cyberforensics and Digital Evidence, ForensicsAnalysis of E-Mail.

Unit–V:	No. of Lectures: 09 Hours	Marks: 12
Computer Forensics: Digital Fo	rensics Life Cycle, Chain of Cust	ody Concept, Network Forensics,
Approaching a Computer Forensia	cs Investigation, Computer Forensi	ics and Steganography, Relevance
of the OSI 7 Layer Model to C	Computer Forensics, Forensics an	d Social Networking Sites: The
Security/Privacy Threats, Challeng	ges in Computer Forensics, Special	l Tools and Techniques, Forensics
Auditing, Anti forensics		

Text Books:

1. Nina Godbole, Sunil Belapure, "Cyber Security", Wiley India Publication, 2011.

Reference Books:

- 1. Nina Godbole, "Information Systems Security", Wiley India Publication, 2nd edition, 2017.
- V.K. Pachghare, "Cryptography and Information security", PHI Learning Pvt Ltd, 2nd edition, 2015.

	Power System Protection Laboratory						
LAB COURSE OUTLINE							
Course	Power S	ystem Protection Laboratory		Short	PSP Lab	Course	
Title: Code:							
Course d	aganintian						
Switchge	ar and Pro	L. tection is a fascinatin	a subject A protecti	ion schen	he in a nowe	r system is	designed
to contin	uously mo	point on the power syst	em to ensure maxi	mim con	tinuity of el	ectrical su	only with
minimum	damage to	o life, equipment and	property. The subje	ct practic	al explores t	he knowled	lge of arc
interrupti	on, differe	nt type of circuit brea	akers and relay. This	knowled	lge is help fu	ill for unde	rstanding
the cha	racteristicf	eatureandproperselec	tionofprotectiveelem	entsindif	ferentprotect	ive scher	ne. The
practical	also provid	le knowledge differer	nt protection for majo	or and ind	lividual powe	er system e	lements.
Laborate	ory	Hours/week	No. of weeks	Total h	ours	Semester	[,] credits
		02	14		28	0	1
End Sem	ester Exa	m (ESE) Pattern:	Practica	al (PR)			
Prerequi	site cours	e(s):					
Power Sy	stem-I, Po	wer System-II					
Course o	bjectives:						
The object	ctives of su	ubject that students w	ill able understand t	he fault c	haracteristic	of individu	al power
system e	lements. (One should also be	knowledgeable abou	it the tri	pping chara	cteristics o	f various
protective	e relays. Th	ne students able to uno	lerstand the job of pr	otection	engineer is to	devise suc	h scheme
where clo	sest possib	ble match between the	fault characteristic a	nd trippir	ng characteris	stic is obta	ined. The
students	will able u	nderstand protected z	cone and able to des	ign prote	ctive scheme	such that	relay will
detect un	desirable c	conditions and then the	rip to disconnect the	area affe	ected, but rer	nain restrai	ned at all
other time	e. Student	should be equipped w	with sound concept o	f power s	system protec	ction to ena	ible those
handling	unforeseer	i circumstances in rea	l life.				
Course o	utcomes						
Upon suc	cessful con	mpletion of lab Cours	e student will be ab	le to:			
1 An	alvze the a	rc formation and arc	extinction phenomer	ion			
2. An	alyze the a alyze Over	current & earth fault	protection scheme for	or alternat	or.		
3. Ex	olain Prote	ction of 3 phase trans	former using differe	ntial relay	/ .		
4. Exp	plain differ	cential protection sche	me applied to transfo	ormer.			
5. De	monstrate	microprocessor based	protection.				
		LA	B COURSE CONT	ENT			

Power System Protection Laboratory		Semester: VIII		
Teaching Scheme:		Examination scheme		
Practical:	2 hours/week	End Semester Exam (ESE):25		
		Internal Continuous Assessmen	nt (ICA):	25 marks

Teacher should facilitate learning following lab experiments:

- 1. To conduct and study of Arc extinction phenomenon: Application in air circuit breaker.
- 2. Study of relaying components and control circuit developments.
- 3. To conduct and plot the characteristic of rewirable fuses and MCB.
- 4. To conduct and plot operating characteristics of Inverse time over current relay.
- 5. To conduct over current & earth fault protection scheme for alternator.
- 6. To conduct Protection of 3 phase transformer using differential relay (Merz- Price protection scheme).
- 7. To conduct and study the through fault stability of differential protection scheme applied to transformer.
- 8. To conduct Protection of transmission line.
- 9. Study of MHO distance relay to plot. a) R-X diagram b) Relay voltage Vs Admittance characteristic.
- 10. Study of Static relay.
- 11. Demonstration of microprocessor base protection.
- Note: Lab file should consist of minimum Eight experiments.

Text Books:

1. Sunil S. Rao, "Switchgear Protection and Power Systems", Khanna Publishers, 14th edition, 2019.

Reference Books:

- 1. Y.G.Paithankar,S.R.Bhide, "Fundamentals of Power System Protection", PHI Publications, Second Edition, 2013.
- 2. T.S. Madharao, "Power System Protection: Static Relays with Microprocessor Applications", Tata McGraw Hill, Second Edition, 2017.
- 3. B. Ravindranath, M. Chandar, "Power System Protection & Switchgear", New Age International Publishers, Second Edition, 2018.
- 4. B. Ram, D.N. Vishwakarma, "Power System Protection & Switch Gear", Mc Graw Hill Education, Second Edition, 2017.
- 5. Stanley H. Horowitz, Arun G. Phadke, "Power System Relaying", Wiley Blackwell Publications, Third Edition.2008.
- 6. J.B. Gupta, "Fundamentals of Switchgear and Protection", S.K. Kataria and Sons Publishers, 2013.
- 7. <u>http://nptel.iitm.ac.in</u>

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical

assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

High Voltage Engineering laboratory								
	LAB COURSE OUTLINE							
Course	High Vo	tage Engineering		Short	HVELAB	Course		
Title: laboratory		Title:		Code:				
Course d	escription	•						
In this lat	oratory, co	ourse emphasis on im	parting p	ractical ki	nowledge and under	standing of hig	gh voltage	
testing e	quipment's	, different insulatin	g mater	als and i	ts breakdown pher	nomenon, hig	h voltage	
laboratori	les and tes	sting of high voltage	e equipn	nent. The	lab course also pr	ovides the pl	atform to	
understan	d generation	on and measurement	of high v	oltages.				
		Hours/week	No. e	of weeks	Total hours	Semeste	r credits	
Lecture		02		14	28		~	
Laborato	ory	02		14	28		3	
End Sem	ester Exa	n (ESE) Pattern:		Oral (OR)			
Prerequi	site course	e(s):						
Basic scie	ences, matl	nematics and subjects	of Elect	rical Engi	neering			
Course o	bjectives:							
The obje	ctive of th	e laboratory is to im	part the	fundamen	ntal knowledge of h	igh voltage g	enerating,	
measurin	g and test	ing instruments. The	e studen	ts will at	le to understand c	oncept and b	reakdown	
phenome	non of diel	ectrics, corona discha	rges, me	thods of g	eneration and Measu	rement of high	n voltages	

and currents and testing of high voltage equipment's. In this lab course, students will be familiar with the use of different equipment's, safety precautions on work place. This makes bridge on theoretical knowledge and practical practices.

Course outcomes:

Upon successful completion of lab Course, student will be able to:

- 1. Apply the concepts of High Voltage Engineering through laboratory experimental work and Connect the circuit to perform experiments, measure, analyze the observed data to come to a conclusion
- 2. Evaluate the performance of breakdown testing of various dielectrics.
- 3. Calibrate the breakdown voltage of air using sphere-gap assembly.
- 4. Visualize and analyze the corona effect.
- 5. Understand the methods of generation and Measurement of high voltages and currents and testing of various electrical equipments.

LAD COUDCE CONTENT						
High Voltage Engin	leering laboratory	Semester:	VIII			
Teaching Scheme:	J	Examination scheme				
Lectures:	2 hours/week	End Semester Exam (ESE):		25 marks		
Practical:	2 hours/week	Internal Continuous Assessme	nt (ICA):	25 marks		
				20 mm m		
Theory:						
Unit–I: Introduction	n to High voltage Lał)S				
Classification of high	h voltage laboratories,	High voltage laboratory layout, tes	ting facility r	equirements,		
High Voltage laborat	tories all over the work	d.	0.	1		
Unit–II: Breakdow	n in Gases					
Gases as insulating 1	media, collision proces	ss, ionization process, Breakdown	in Electroneg	ative Gases,		
Corona Discharges, I	Breakdown in Vacuum	- 1.	C			
Unit–III: Breakdow	vn in Liquids and soli	ds				
Liquids as Insulator	s, Conduction and Br	eakdown in Pure Liquids and Co	ommercial Li	quids. Solid		
dielectrics and comp	posite dielectrics, Intr	insic Breakdown, Electromechani	cal Breakdov	vn, Thermal		
Breakdown.						
Unit-IV: Generatio	n and measurement of	of High Voltages and currents				
Methods of Generati	ion of high dc voltage	s, ac voltages and impulse voltage	e, voltage dou	ubler circuit,		
voltage multiplier c	ircuit, multistage imp	ulse generator, impulse current	generator. Sp	oark gap for		
measurement of high	n dc, ac and impulse ve	oltages, Klydonograph, other techr	niques for imp	pulse current		
measurements						
Unit–V: High Volta	ge Testing of Electric	cal Apparatus				
Various standards fo	r HV Testing of electr	ical apparatus, IS, ANSI, IEC stan	dards, testing	of overhead		
line insulators, testin	g of power capacitor, t	esting of circuit breakers, testing o	f cables, test	voltage.		
Teacher should facili	itate learning following	g lab experiments:				
1. Study of 100) kV high voltage testir	ng set.				
2. Determinatio	on of insulating break-	down strength of solid, liquid and g	gaseous dielec	etric media.		
3. Study of core	ona discharge.					
4. Double volta	ige double frequency w	vithstand test on transformer.				
5. Calibration of	of sphere gap.					
6. Study of Imp	bulse Voltage Generato					
/. Parametric A	Analysis of Impulse Vo	bitage waveform				
8. Study of Imp	buise Current Generato					
9. Parametric A	manysis of Impulse Cu	irrent waveform				
10. Critical Flas	nover of a Sphere Gap	using IVG				
11. Functioning	or voltage Doubler	Aultiplior				
12. 3-Stage Coc	d consist of minimum	viulupiter Eight experiments				
THOLE: Lab The should		Lignt experiments.				

Text Books:

- 1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, Fifth Edition, 2013.
- 2. C. L. Wadhwa, "High Voltage Engineering", New Age publishers, New Delhi, 3rd edition, 2010.
- 3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
- 4. R. Arora, W. Mosch "High Voltage and Electrical Insulation Engineering", Wiley-IEEE Press; 1st edition, 2011.
- 5. http://nptel.iitm.ac.in/courses.php

Reference Books:

- 1. E. Kuffel, W. S. Zaengl and J. Kuffel, "High Voltage Engineering Fundamentals", Newnes Publication, 2nd edition, 2008.
- 2. Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New Age International Publishers, New Delhi, 2010.
- 3. D. V. Razevig, "High Voltage Engineering Fundamentals", Khanna Publishers, 2nd edition, 1993.

Guide lines for ICA:

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guidelines for ESE:

ESE will be based on the Laboratory assignments submitted by the students in the form of journal. In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work, performance and understanding.

]	Project					
		L	AB COU	JRSE OUTI	LINE				
Course Title:				Project	Short	PROJ	C	Course	
~ ~ ~					Title:		C	Code:	
Course descript	ion:		_						
Project represent	s the culn	nination of s	tudy tow	ards the Ba	chelor of E	Ingineerin	ng degr	ee. The pro	oject
offers the opport	unity to a	pply and ext	end mate	erial learned	throughou	t the prog	gram. T	he emphas	SIS 1S
necessarily on fa	cilitating s		ng in tec	nnical, proje	ct manager	nent and j	present	ation spher	es.
	Hour	s/week	INO. 0	of weeks	1 otal	nours	Ser	nester cre	aits
	(5)(7)	00		14	8	4		03	
End Semester E	xam (ESE	E) Pattern:	Oral (C	JR)					
Prerequisite course(s):									
Course altraction									
Lourse objective	es:	ia concenta (- head e	minainlas of	maiaata				
1. To understa	nd the value	ic concepts a	k broad j	officipies of	projects.	ontation 8	r comn	lation	
2. To understa	theoretic	al concents to	ng periet	roblems with	teamwork	and multi	idiscipl	iculoli. inary appro	ach
4 To demonst	trate profe	essionalism x	vith ethi	cs: present	effective c	ommunic	ation s	kills and r	elate
engineering	issues to l	proader socie	tal conte	es, present		ommunie	ution b	und i	ciute
	100000000								
Course outcome	s:								
Upon successful	completio	n of lab Cou	rse, stude	ent will be al	ole to:				
1. Demonstrate	e a sound t	echnical kno	wledge of	of their selec	ted project	topic.			
2. Undertake p	roblem ide	entification, f	formulati	on and solut	tion.	1			
3. Design engi	neering so	lutions to con	mplex pr	oblems utiliz	zing a syste	ems appro	ach.		
4. Conduct an	engineerin	ig project							
5. Demonstrate	e the know	ledge, skills	and attitu	udes of a pro	ofessional e	ngineer.			
		LA	AB COU	RSE CONT	TENT				
Project			Se	mester:			VIII		
Teaching Schem	ne:		Ex	xamination s	scheme:	ł			
Practical:		6 hours/we	ek Er	nd Semester	Exam (ES	SE): (OR))	50 marks	\$
L		1							

Internal Continuous Assessment	50 marks
(ICA):	

In continuation with Project (Stage – I) at Semester – VII, by the end of Semester – VIII, the students should complete implementation of ideas as formulated in Project (Stage – I). It may involve fabrication / coding, experimentation, data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. It may also include testing, results and report writing. Each student group should submit complete project report at the end of Semester-VIII in the form of Hard bound.

Each student group is required to maintain separate log book for documenting various activities of the project.

Guide lines for ICA:

The Internal Continuous Assessment (ICA) for project shall be based on continuous evaluation of students' performance, active participation, knowledge/skill acquired throughout semester and presentation by the students. The assessment shall be done jointly by the guide and departmental committee. A three-member departmental committee including guide, appointed by Head of the department, shall be constituted for the assessment. The assessment for Project in Semester – VIII shall be as per the guidelines given in Table – 2.

	Assessment by Guide				Assessment by Departmental Committee			
Name	Attendance /	Implementation	Results	Report	Depth of	Presentation	Demonstration	Total
of the	Participation				Understanding			
Student								
Marks	5	5	5	5	10	10	10	50
o Sti	f the udent Marks	f the Participation udent Marks 5	f the Participation Marks 5 5	f the adent Participation Marks 5 5 5	f the adent Participation Marks 5 5 5 5 5	f the adent Participation Understanding Marks 5 5 5 10 Image:	f the adent Participation Understanding Marks 5 5 5 10 10 Image: Imag	f the adent Participation Understanding Marks 5 5 5 10 10 Image: Imag

Guidelines for ESE:

In End Semester Examination (ESE), the student may be asked for presentation/demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.