

# **GOVERNMENT COLLEGE OF ENGINEERING**

SALEM - 636 011

(An Autonomous Institution Affiliated to Anna University, Chennai)

# **REGULATIONS 2023**

# **CURRICULAM AND SYLLABUS**

(For Candidates admitted from 2023 - 2024 onwards)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING (PART TIME PROGRAMME)

## VISION OF THE DEPARTMENT

• To make ethically and emotionally strong Electrical Engineers of high caliber capable of meeting the national and global technological challenges for the well-being of the Society.

# MISSION OF THE DEPARTMENT

- To Impart state of the art Knowledge in Electrical Science and Technology through under-graduate and graduate programmes.
- To develop the Electrical Engineering Department as a Centre of Excellence in Power Electronics and Industrial Drives.
- To provide Knowledge base and Consultancy services to the society at large and in particular for the upliftment and well-being of the rural and tribal communities.

## VISION AND MISSION OF THE INSTITUTION

### Vision

- We envision our students as excellent Engineers not only in the field of Science and Technology, but also in good citizenship and discipline.
- Our commitment lies in producing comprehensive knowledge seekers and humane individuals, capable of building a strong and developed nation.

### Mission

- To impart update technical education and knowledge.
- To groom our young students to become professionally and morally sound engineers.
- To teach global standards in production and value-based living through honest and scientific approach.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- **PEO 1:** Graduates will be employed electrical engineering profession as experts in solving electrical engineering problems by their depth of understanding in core electrical knowledge and/or completed/pursuing post graduate study or research.
- **PEO 2:** Graduates will have awareness for lifelong learning and continued professional development
- **PEO 3:** Graduates will demonstrate creativity in their engineering practices including entrepreneurial and collaborative ventures with strategic thinking, planning and execution.
- **PEO 4:** Graduates will communicate effectively, recognize and incorporate societal needs and constraints in their professional endeavors and practice their profession with high regard to legal and ethical responsibilities.
- **PEO 5:** Graduates will have necessary foundation on computational platforms and software applications related to the field of electrical and electronics engineering.

#### **PROGRAM OUTCOMES (POs)**

#### Engineering Graduates will be able to

- **PO 1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO 2: Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO 3**: **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO 4**: **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO 5**: **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- **PO 6**: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- **PO 7**: **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- **PO 8**: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- **PO 9**: **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO 10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO 11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environment
- **PO 12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **PROGRAM SPECIFIC OUTCOMES (PSOs)**

#### Electrical and Electronics Engineering Graduates will be able to

- **PSO 1:** Apply knowledge of mathematics, engineering sciences and multidisciplinary knowledge to the solution of electrical and electronics engineering problems.
- **PSO 2:** Apply research-based knowledge, appropriate techniques, IT tools to complex Electrical and Electronics Engineering problems including design, analysis, interpretation of data, and synthesis of the information to provide valid conclusions.
- **PSO 3:** Apply ethical principles, management skills and lifelong learning for professional development and personnel growth.

# B.E. (ELECTRICAL AND ELECTRONICS ENGINEERING) [PART TIME] CURRICULUM AND SYLLABUS REGULATIONS – 2023

		SEME	ESTER - I							
SI No	Course Code	Course Title	Category		urs Vee	-	Credit	Maxi	imum	Marks
No				L	Т	Р	С	CA	FE	Total
THE	ORY		T		r –				1	
1.	23PTMA101	Mathematics-I	BS	3	0	0	3	40	60	100
2.	23PTEE101	Electric Circuit Analysis	PC	2	1	0	3	40	60	100
3.	23PTEE102	DC Machines and Transformers	PC	2	1	0	3	40	60	100
4.	23PTEE103	Electron Devices and Circuits	PC	3	0	0	3	40	60	100
5.	23PTCS101	Fundamental of Problem Solving and C Programming	ES	3	0	0	3	40	60	100
		TOTAL					15			500
		SEME	STER – II				1	1		
Sl No	Course Code	<b>Course Title</b>	Category	1	urs Wee	-	Credit			Marks
				L	Τ	Р	С	CA	FE	Total
THE	ORY	1	1	1			1	1		
1.	23PTMA201	Mathematics-II	BS	3	0	0	3	40	60	100
2.	23PTEE201	Electromagnetic Theory	PC	2	1	0	3	40	60	100
3.	23PTEE202	Synchronous and Induction Machines	PC	2	1	0	3	40	60	100
4.	23PTEE203	Analog and Digital Integrated Circuits	PC	3	0	0	3	40	60	100
PRA	CTICAL									
5.	23PTEE204	Electrical Machines Laboratory	PC	0	0	3	1.5	60	40	100
		TOTAL					13.5			500
		SEMES	STER – III							
SI No	Course Code	Course Title	Category		urs Vee	k	Credit			Marks
				L	Τ	Р	С	CA	FE	Total
THE	ORY		1	1			1		1	
1.	23PTEE301	Control Systems	PC	2	1	0	3	40	60	100
2.	23PTEE302	Power Electronics	PC	3	0	0	3	40	60	100
3.	23PTEE303	Electrical Machine Design	PC	2	1	0	3	40	60	100
4.	23PTEE304	Measurements and Instrumentation	PC	3	0	0	3	40	60	100
5.	23PTCY301	Environmental Science and Engineering	ES	3	0	0	3	40	60	100
		TOTAL					15			500

		SEME	STER – IV							
SI No	Course Code	Course Title	Category		urs Wee	-	Credit	Maxi	imum	Marks
	_			L	Т	Р	С	CA	FE	Total
THE	CORY		1		r			1		
1.	23PTEE401	Power Generation, Transmission, and Distribution System	PC	2	1	0	3	40	60	100
2.	23PTEE402	Microprocessor and Microcontroller	PC	3	0	0	3	40	60	100
3.	23PTEE403	<b>Biomedical Instrumentation</b>	PC	3	0	0	3	40	60	100
4.	23PTHS401	Universal Human Values	HS	2	1	0	3	40	60	100
PRA	CTICAL		1				1			
5.	23PTEE404	Microprocessor and Microcontroller Laboratory	PC	0	0	2	1	60	40	100
		TOTAL					13			500
		SEME	STER – V							
SI No	Course Code	<b>Course Title</b>	Category		urs Wee	-	Credit	Max	imum	Marks
				L	Т	Р	C	CA	FE	Total
THE	ORY	[	1	1	r		1		1	
1.	23PTEE501	Power System Analysis and Stability	PC	2	1	0	3	40	60	100
2.	23PTEE502	Protection and Switchgear	PC	3	0	0	3	40	60	100
3.	23PTEE503	Electrical Drives and Control	PC	3	0	0	3	40	60	100
4.	23PTEE504	Special Electrical Machines	PC	3	0	0	3	40	60	100
PRA	CTICAL			•					L	
5.	23PTEE505	Power Electronics and Drives Laboratory	PC	0	0	3	1.5	60	40	100
		TOTAL					13.5			500
		SEME	<u>STER – VI</u>							
Sl No	Course Code	Course Title	Category		urs Wee	k	Credit		•	Marks
				L	Т	Р	C	CA	FE	Total
THE	CORY		1		T				1	
1.	23PTEE601	Power System Operation and Control	PC	3	0	0	3	40	60	100
2.	23PTEE602	Utilization of Electrical Energy	PC	3	0	0	3	40	60	100
3.	23PTEE603	Solar and Wind Energy Conversion Systems	PC	3	0	0	3	40	60	100
4.	23PTEEE1X	Professional Elective-I	PE	3	0	0	3	40	60	100
5.	23PTEEE2X	Professional Elective-II	PE	3	0	0	3	50	60	100
		TOTAL					15			500

		SEME	ESTER – VII									
SI	Course	Course Title	Category		ours Wee	-	Credit	Maxi	Maximum Marks			
No	Code			L	Т	Р	С	CA	FE	Total		
THE	EORY	1										
1.	23PTEE701	High Voltage Engineering	PC	3	0	0	3	40	60	100		
2.	23PTEE702	Smart Grid Technologies	PC	3	0	0	3	40	60	100		
3.	23PTHS701	Industrial Management and Economics	PC	3	0	0	3	40	60	100		
4.	23PTEEE3X	Professional Elective-III	PE	3	0	0	3	40	60	100		
5.	23PTEEE4X	Professional Elective-IV	PE	3	0	0	3	40	60	100		
	•	TOTAL					15			500		
		SEME	STER – VIII					1				
SI	Course	Course Title	Category		urs Wee	-	Credit	Maxi	imum	Marks		
No	Code			L	Т	Р	С	CA	FE	Total		
THE	EORY											
1.	23PTEEE5X	Professional Elective-V	PE	3	0	0	3	40	60	100		
2.	23PTEEE6X	Professional Elective-VI	PE	3	0	0	3	40	60	100		
3.	23PTEEE7X	Professional Elective-VII	PE	3	0	0	3	40	60	100		
PRA	CTICAL											
4.	23PTEE801	Project Work	EEC	0	0	6	3	120	80	200		
		TOTAL					12			600		
	GI	RAND TOTAL					112					

# B.E. (Electrical and Electronics Engineering) [Part Time] PROFESSIONAL ELECTIVES COURSES

SI.	Course	Course Title	Category		ours p Week		Credit	Maxi	imum	Marks
No.	Code		gj	L	Т	Р	С	CA	FE	Total
		ELECTIVE – I (V	I SEMEST	ER)						
1.	23PTEEE11	Advanced Control Systems	PE	3	0	0	3	40	60	100
2.	23PTEEE12	Discrete Control Systems	PE	3	0	0	3	40	60	100
3.	23PTEEE13	Digital Controller in Power Electronics Applications	PE	3	0	0	3	40	60	100
4.	23PTEEE14	Robotics and Automation	PE	3	0	0	3	40	60	100
5.	23PTEEE15	Industrial Automation and Control	PE	3	0	0	3	40	60	100
		ELECTIVE – II (V	I SEMEST	'ER)						
1.	23PTEEE21	HVDC Transmission Systems	PE	3	0	0	3	40	60	100
2.	23PTEEE22	EHVAC Transmission Systems	PE	3	0	0	3	40	60	100
3.	23PTEEE23	Flexible AC Transmission System	PE	3	0	0	3	40	60	100
4.	23PTEEE24	Substation Engineering and Automation	PE	3	0	0	3	40	60	100
5.	23PTEEE25	Power System Automation	PE	3	0	0	3	40	60	100
		ELECTIVE – III (V	II SEMES	<b>FER</b>	)					
1.	23PTEEE31	Power System Transients	PE	3	0	0	3	40	60	100
2.	23PTEEE32	Distributed Generation and Microgrid	PE	3	0	0	3	40	60	100
3.	23PTEEE33	Restructured Power System	PE	3	0	0	3	40	60	100
4.	23PTEEE34	Power Quality	PE	3	0	0	3	40	60	100
5.	23PTEEE35	Power Plant Engineering	PE	3	0	0	3	40	60	100
		ELECTIVE – IV (V	II SEMES	<b>FER</b>	)					
1.	23PTEEE41	Industrial Electrical System	PE	3	0	0	3	40	60	100
2.	23PTEEE42	Modern Electrical Drives	PE	3	0	0	3	40	60	100
3.	23PTEEE43	Multilevel Power Converters	PE	3	0	0	3	40	60	100
4.	23PTEEE44	Modelling and Control of Power Converters	PE	3	0	0	3	40	60	100
5.	23PTEEE45	Control and Integration of Renewable Energy Sources	PE	3	0	0	3	40	60	100

		ELECTIVE – V (V	III SEMES	STER	)					
1.	23PTEEE51	Digital Signal Processing	PE	3	0	0	3	40	60	100
					-	Ŭ				
2.	23PTEEE52	Embedded System Design	PE	3	0	0	3	40	60	100
3.	23PTEEE53	Artificial Intelligence and Computer Vision	PE	3	0	0	3	40	60	100
4.	23PTEEE54	Soft Computing	PE	3	0	0	3	40	60	100
5.	23PTEEE55	Internet of Things for Electrical System	PE	3	0	0	3	40	60	100
		ELECTIVE – VI (V	III SEME	STER	)					
1.	23PTEEE61	Electrical Energy Conservation and Auditing	PE	3	0	0	3	40	60	100
2.	23PTEEE62	Electrical Wiring, Estimation and Costing	PE	3	0	0	3	40	60	100
3.	23PTEEE63	Energy Management System and SCADA	PE	3	0	0	3	40	60	100
4.	23PTEEE64	Digital Protection of Electrical System	PE	3	0	0	3	40	60	100
5.	23PTEEE65	Traction Engineering	PE	3	0	0	3	40	60	100
		ELECTIVE – VII (V	III SEME	STER	<b>k</b> )					
1.	23PTEEE71	Electric Vehicles and Control	PE	3	0	0	3	40	60	100
2.	23PTEEE72	Testing of Electric Vehicles	PE	3	0	0	3	40	60	100
3.	23PTEEE73	Hybrid Electric Vehicles	PE	3	0	0	3	40	60	100
4.	23PTEEE74	Battery Management Systems	PE	3	0	0	3	40	60	100
5.	23PTEEE75	Energy Storage Systems and Applications	PE	3	0	0	3	40	60	100

SI.	<b>C C A</b>			Cre	edits	per Sen	nester			Total
No	Course Components	Ι	II	ш	IV	V	VI	VII	VIII	Credits
1.	Humanities and Social Science (HS)				3			3		6
2.	Basic Sciences (BS)	3	3							6
3.	Engineering Sciences (ES)	3		3						6
4.	Professional Core (PC)	9	10.5	12	10	13.5	9	6		70
5.	Professional Electives (PE)						6	6	9	21
6.	Open Electives (OE)									
7.	Employment Enhancement Course (EEC)								3	3
8.	Mandatory / Management / Non-Credit Course (MC/HSMC)									
	<b>Total Credits</b>	15	13.5	15	13	13.5	15	15	12	112

# SUMMARY OF CREDITS FOR PART-TIME STREAM

23PTMA101	MATHEMATICS – I (Common to Part Time B.E CIVIL, ECE, EEE & ME	CH Branches)	SEM	1ES]	<b>FER</b>	Ι
PREREQUIS	ITES	CATEGORY	BS	Cr	edit	3
Basic 12th level	knowledge of ODE, PDE, Vector algebra and Complex	Hours / Week	L	Т	Р	TH
Analysis.		Hours / week	3	0	0	3
Course Object	tives:					
	he student acquire sound knowledge of techniques in solving og problems.	ordinary differentia	al equa	tions	that r	nodel
<sup>2</sup> . problems.	he student to understand the techniques in solving partial diffe	-			engine	eering
3. To acquain	t the student with the concepts of vector calculus needed for solv	ving engineering p	roblem	s.		
4. To underst	and the concept of analytic functions.					
5. To obtain t	he knowledge of complex integration					
UNIT I ORI	DINARY DIFFERENTIAL EQUATIONS		9	0	0	9
Higher order lin Legendre's linea	ear differential equations with constant coefficients – Method or equations.	of variation of para	ameters	5 – Ca	auchy'	's and
UNIT II PA	RTIAL DIFFERENTIAL EQUATIONS		9	0	0	9
1	rtial differential equations by elimination of arbitrary constants a	and arbitrary functi		v	v	
-		•		Lagra	nge s	mica
equation – Home	ogeneous Linear partial differential equations of second order wi		ients			
equation – Home	ogeneous Linear partial differential equations of second order wi		ients.			
-			1	0	0	9
UNIT III VI	ECTOR CALCULUS		9	0	0	<b>9</b>
UNIT III VI Gradient, diverg	ECTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen	oidal vector fields	<b>9</b> 5 – Vec		itegrat	tion -
UNIT III VI Gradient, diverg Statement of G	ECTOR CALCULUS	oidal vector fields	<b>9</b> 5 – Vec		itegrat	tion -
UNIT III VI Gradient, diverg	ECTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen	oidal vector fields	<b>9</b> 5 – Vec		itegrat	tion -
UNIT III VI Gradient, diverg Statement of G parallelopipeds.	ECTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen	oidal vector fields	<b>9</b> 5 – Vec		itegrat	tion -
UNIT III     VE       Gradient, diverg       Statement of G       parallelopipeds.       UNIT IV     AN	ECTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl	oidal vector fields ications involving	<b>9</b> s – Vec cubes <b>9</b>	and <b>0</b>	ntegrat rectar	tion - ngula 9
UNIT IIIVFGradient, divergStatement of Gparallelopipeds.UNIT IVANFunctions of a c	CTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl	ioidal vector fields ications involving Cauchy – Riemann	9 cubes 9 equation	and 0 on an	ntegrat rectar 0 d suff	tion - ngular <b>9</b> ïcien
UNIT IIIVEGradient, divergStatement of Gparallelopipeds.UNIT IVANFunctions of a cconditions (exclusion)	CTOR CALCULUS ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl NALYTIC FUNCTIONS omplex variable – Analytic functions – Necessary conditions, C	ioidal vector fields ications involving Cauchy – Riemann	9 cubes 9 equation	and 0 on an	ntegrat rectar 0 d suff	tion - ngula <b>9</b> icien
UNIT IIIVEGradient, divergStatement of Grazilelopipeds.UNIT IVANFunctions of a cconditions (excluConformal mapp	<b>EXAMPLE 1 CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>EXALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- ping: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation.	ioidal vector fields ications involving Cauchy – Riemann	9 cubes 9 equation	and 0 on an	ntegrat rectar 0 d suff	iion ngular <b>9</b> iicient
UNIT IIIVEGradient, divergStatement of Gparallelopipeds.UNIT IVANFunctions of a cconditions (excluConformal mappUNIT VCO	<b>EXAMPLEX INTEGRATION</b> <b>CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>VALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- ping: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation.	oidal vector fields ications involving Cauchy – Riemann Igate – construction	9 cubes 9 equation n of ana 9	and 0 on an alytic	o tegrat rectar 0 d suff functi	iion - ngula: 9 iicien ions -
UNIT III     VE       Gradient, diverg       Statement of G       parallelopipeds.       UNIT IV     AN       Functions of a c       conditions (exclu       Conformal mapp       UNIT V     CC       Complex integra	<b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b>	coidal vector fields ications involving Cauchy – Riemann igate – construction and Cauchy's inte	9 cubes 9 equation of and gran for	and 0 on an alytic 0 rmula	0 d suff functi	ion - ngula 9 icien ions - 9 ylor'
UNIT III       VI         Gradient, diverg         Statement of Graparallelopipeds.         UNIT IV       AN         Functions of a c         conditions (exclusion)         Conformal mapp         UNIT V       CC         Complex integra         and Laurent's exclusion	<b>EXAMPLEX INTEGRATION</b> <b>CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>VALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- bing: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation. <b>OMPLEX INTEGRATION</b> tion – Statement and applications of Cauchy's integral theorem pansions – Singular points – residues – Residue theorem – Appli-	coidal vector fields ications involving Cauchy – Riemann igate – construction and Cauchy's inte	9 cubes 9 equation of and gran for	and 0 on an alytic 0 rmula	0 d suff functi	iion - ngular <b>9</b> iicien ions - <b>9</b> ylor's
UNIT III       VI         Gradient, diverg         Statement of Graparallelopipeds.         UNIT IV       AN         Functions of a c         conditions (exclusion)         Conformal mapp         UNIT V       CC         Complex integra         and Laurent's exclusion	<b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>EXAMPLEX INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b> <b>INTEGRATION</b>	coidal vector fields ications involving Cauchy – Riemann igate – construction and Cauchy's inte	9 cubes 9 equation of and gran for	and 0 on an alytic 0 rmula	0 d suff functi	ion - ngula 9 icien ions - 9 ylor'
UNIT III       VI         Gradient, diverg         Statement of Graparallelopipeds.         UNIT IV       AN         Functions of a c         conditions (exclusion)         Conformal mapp         UNIT V       CC         Complex integra         and Laurent's exclusion	<b>EXAMPLEX INTEGRATION</b> <b>CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>VALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- bing: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation. <b>OMPLEX INTEGRATION</b> tion – Statement and applications of Cauchy's integral theorem pansions – Singular points – residues – Residue theorem – Appli-	ooidal vector fields ications involving Cauchy – Riemann gate – construction and Cauchy's inte lication of residue	9 cubes equation of ana g egral fo theorem	and <b>0</b> on an alytic <b>0</b> rmula n to e	0       0       d suff       functi       0       1 - Ta       valuat	9 icien ions - 9 ylor' e rea
UNIT III       VI         Gradient, diverg         Statement of Graparallelopipeds.         UNIT IV       AN         Functions of a c         conditions (exclusion)         Conformal mapp         UNIT V       CC         Complex integra         and Laurent's exclusion	<b>EXAMPLEX INTEGRATION</b> <b>CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>VALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- bing: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation. <b>OMPLEX INTEGRATION</b> tion – Statement and applications of Cauchy's integral theorem pansions – Singular points – residues – Residue theorem – Appli-	coidal vector fields ications involving Cauchy – Riemann igate – construction and Cauchy's inte	9 cubes equation of ana g egral fo theorem	and <b>0</b> on an alytic <b>0</b> rmula n to e	0       0       d suff       functi       0       1 - Ta       valuat	9 icien ions - 9 ylor' e rea
UNIT III       VI         Gradient, diverg         Statement of Graparallelopipeds.         UNIT IV       AN         Functions of a c         conditions (exclusion)         Conformal mapp         UNIT V       CC         Complex integra         and Laurent's existintegrals over se	<b>EXAMPLEX INTEGRATION</b> <b>CTOR CALCULUS</b> ence and curl – Directional derivative – Irrotational and solen auss divergence theorem and Stokes theorem – Simple appl <b>VALYTIC FUNCTIONS</b> omplex variable – Analytic functions – Necessary conditions, C uding proofs) – Properties of analytic function – Harmonic conju- bing: $w = z + c$ , $cz$ , $\frac{1}{z}$ and bilinear transformation. <b>OMPLEX INTEGRATION</b> tion – Statement and applications of Cauchy's integral theorem pansions – Singular points – residues – Residue theorem – Appli-	ooidal vector fields ications involving Cauchy – Riemann gate – construction and Cauchy's inte lication of residue	9 cubes equation of ana g egral fo theorem	and <b>0</b> on an alytic <b>0</b> rmula n to e	0       0       d suff       functi       0       1 - Ta       valuat	9 icien ions - 9 ylor' e rea
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4.	R.K. Jain and S.R.K. Iyengar, "Advanced Engineering Mathematics", 3 <sup>rd</sup> Edition, Narosa Publishing House Pvt.
	Ltd., 2007.

		Outcomes: npletion of this course, the students will be able to:	Bloom's Taxonomy Mapped
CO1	:	Find the techniques of solving ordinary differential equations that arise in engineering problems.	L3: Applying
CO2	:	Find the techniques of solving partial differential equations that arise in engineering problems.	L3: Applying
CO3	:	Apply the concept of vector calculus and vector integration.	L3: Applying
CO4	:	Understand analytic function and its properties.	L2: Understanding
CO5	:	Evaluate various integrals by using Cauchy's residue theorem.	L5: Evaluating

231	PTEE101	ELECTRIC CIRCUIT ANALYSIS		SEM	EST	ER	Ι
PR	EREQUIS	TES (	CATEGORY	PC	Cre	dit	3
N	Iathematics	I	Iours / Week	L	Τ	P	TH
			IUIIS/ WEEK	2	1	0	3
Coi	irse Object						
1.		e electric circuits and its analysis.					
2.		nowledge on solving circuits using network theorems.					
3. 4.		the phenomenon of resonance in coupled circuits. on obtaining the transient response of circuits.					
4. 5.		asor diagrams and analysis of three phase circuits.					
5.	10 leann ph	asor diagrams and anarysis of three phase circuits.					
UN	IT I BA	SIC CIRCUITS ANALYSIS		6	3	0	9
		irchhoff's laws – DC and AC Circuits – Resistors in series and pa	rallel circuits –M	lesh cu		t and	node
		of analysis for DC and AC Circuits – Phasor diagram - power, power					
TINI		TWORK REDUCTION AND NETWORK THEOREMS H	FOR DC AND	(	2	0	
UN		CIRCUITS		6	3	0	9
Net	work reduct	on: voltage and current division, source transformation- star an	d delta transfor	mation	, sur	perpo	sition
		hevenin's and Norton's Theorem — Maximum power tran	sfer theorem – F	Recipro	city	Theo	rem -
subs	stitution theo	rem.					
						0	
		SONANCE AND COUPLED CIRCUITS		6	3	0	9
		el resonance – frequency response – Quality factor and Bandwidth - S					
	double tuned	rule – analysis of coupled circuits –coupled circuits in series and paral	lel – I uned circu	its – an	alysi	sof	single
and	double tuned	i circuits.					
TINI		ANSIENT ANALYSIS		6	3	•	9
		se of RL, RC and RLC Circuits using Laplace transform for DC input	t and AC simular	•	-	0	9
Trai	isient respon	se of RL, RC and RLC Circuits using Laplace transform for DC inpu	it and AC sinusoi	dai inp	but.		
							_
		REE PHASE CIRCUITS		6	3	0	9
		nced/ unbalanced voltage sources - analysis of three phase three with					
		with balanced and unbalanced loads – phasor diagrams of voltages a	and currents -pov	ver and	d pov	ver fa	actor
mea	surements in	three phase circuits	<b>F</b> -4-1 (20 <b>T</b> + 7	1 = (T)	45	D	· · ] -
<b>T</b>	4 D 1	·	<b>Fotal (30L + 2</b>	151):	= 45	Pei	1005
rex	t Books:						
1.	William H.	Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Ca	ircuits Analysis"	TMH	publ	lisher	s, 6th
		w Delhi, 2002.					
2.	Joseph A. H	Edminister, and Mahmood Nahri, "Electric circuits", Schaum"s series	, Tata McGraw-l	Hill, Ne	ew D	elhi,	2001
Cou	rse Outcon	nes:					
Upor	n completion	of this course, the students will be able to:		Bloor Mapp		axoi	ıomy
CO1	: Understa	nd the basic concept of circuit elements, circuit laws and network red	duction technique		Unde	erstan	ding
CO2		e electrical network using mesh and nodal analysis by applying netwo			Appl		
CO3		of AC and Dc circuits using various network theorems.			Anal		5
CO4		nd the resonance in series and parallel circuits and basic concepts of	coupled circuits.				ding
CO5	: Analyse	the transient response of series and parallel A.C. circuits and to solve			Anal		0
COS	time don	nain using Laplace Transform.		L/4.	Anal	yzmę	,

	TEE102	DC MAC	CHINES AND TRANS				IEST		Ι
	EREQUISITES			CATEGO	RY	PC		edit	3
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				iiouis7 V	UUN	2	1	0	3
Cou	rse Objectives:								
1.			mechanical energy conver	sion and to gain the know	vledge	on sir	ngle a	nd mu	ltip
2	excited magnetic			ion of DC moshimos and					
2. 3.			on and principles of operation istics of different types of				•		
<u>3.</u> 4.			machines and transformer		Jineis.	•			
<del>5</del> .			achines and transformers b		ts.				
									1
			AL ENERGY CONVE			6	3	0	9
			MF and force – AC operate and Multiply-excited mag		- Energ	gy in r	nagne	etic sy	sten
- 1.10	end energy & meen	anical loice – Single	e and Multiply-excited mag	gliette field systems.					
UN	IT II DC GEN	ERATORS				6	3	0	9
			rinciple of operation of DC						
		istics of DC generat	ors – Commutation - Arm	ature reaction – Parallel	operati	ion of	f DC g	genera	tor
Арр	lications.								
IINI	TIII DC MO	LUBS				6	3	0	
				T (DC) (DC)		•	-	-	-
r I III					nood	Tora			
f D			EMF - Torque equation - point starter 4 point starter						
	C motors – Startin	g of DC motors: 3-	point starter, 4- point star						
	C motors – Startin		point starter, 4- point star						
curr	C motors – Startin ent control and Arr	g of DC motors: 3- nature voltage contro	point starter, 4- point star						Fie
curr UN	C motors – Startin ent control and Arr	g of DC motors: 3- nature voltage contro FORMERS	point starter, 4- point star ol – Applications.	rter – Speed control of s	hunt an	nd ser	ies m	otor:	Fie
UN Con	C motors – Startin ent control and Arr IT IV TRANS structional feature	g of DC motors: 3- nature voltage contro FORMERS s of single-phase	point starter, 4- point star	rter – Speed control of s	hunt an	nd ser 6 n —ic	ies m 3 leal	otor: 0 transfe	Fie
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Con char – Pa UN Loss test	C motors – Startin ent control and Arr TTIV TRANS structional feature acteristics - Practic rallel operation - A TTV TESTIN ses and efficiency - - Testing of transfo t Books:	g of DC motors: 3- nature voltage contro <b>FORMERS</b> s of single-phase al Transformer work utotransformers - The <b>G OF DC MACH</b> Condition for max rmers: open circuit	point starter, 4- point star ol – Applications. transformers–Principle cing on No- load and Load hree phase transformer con <b>HINES AND TRANSF</b> imum efficiency – Testing and short circuit tests, Sur	rter – Speed control of s of operation - EMF e with phasor diagram – E mections. ORMERS g of DC machines: Swin npner's test – All day eff Total	equation quivale burne's iciency ( <b>30L</b> +	6 n -icent cir 6 s test : y. + 157	ies m 3 leal f cuit – 3 and H $\Gamma$ ) = 4	otor: 0 transfe Regu 0 lopkin 15 Pe	Fie Orm lati
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Cours	se C	Outcomes:	Bloom's Taxonomy
Upon c	com	pletion of this course, the students will be able to:	Mapped
CO1	:	Recite the concepts of electromechanical energy conversion principles.	L1: Remembering
CO2	:	Understand the basic concepts of DC machines and transformers.	L2: Understanding
CO3	:	Evaluate the performance characteristics of DC machines and transformers.	L5: Evaluating
CO4	:	Conduct various tests on DC machines.	L3: Applying
CO5	:	Conduct various test on Transformers	L3: Applying

Hours / Week       L       T       P       TH         Hours / Week       L       T       P       T         To understand the characteristics of diodes.       3       0       0       3         2.       To understand the characteristics of transistors.       3       .	23P	PTEE103 ELECTRON DEVICES AND	CIRCUITS	SEM	IES I	ER	Ι
Hours / Week       3       0       0       3         Course Objectives:       3       0       0       3       0       0       3         1.       To understand the characteristics of transistors.       3       7	PR	EREQUISITES	CATEGORY	PC	Cr	edit	3
Image: Course Objectives:       Image: Course Objectives:         1.       To understand the characteristics of transistors.         2.       To understand the characteristics of transistors.         3.       To design amplifier circuits         4.       To design amplifier circuits.         UNTI I DIODES       9       0       0       9         Structure – Equilibrium conditions – Energy Band Concepts – Zero bias – Forward Bias – Reverse bias – Junctio capacitances – one sided and non-uniformly doped junctions – Ideal PN junction current, P-N junction diode, V.         characteristics of a diode, review of half-wave and full-wave rectifiers. Zener diodes, voltage regulator using Zener diode clamping and clipping circuits.       9       0       0       0       9         UNIT II TRANSISTORS       9       0       0       0       0       9         Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation – Common base common mitter and common collector configurations, Input and output characteristics. Early effect, regions of operation Act and D Coad lines - Need for stability of 0-Point. Bias stability – fixed bias, collector to base bias, self bias. Transiste sustement of stability of 0-Point. Bias tability – fixed bias, collector to base bias, and Piasteristics witching times. Transistor as a switch and an amplifier. Structure and characteristics - UIT structure and characteristics         UNTT III   SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       0       9<			Hours / Week				TH
1.       To understand the characteristics of diodes.         2.       To understand the characteristics of transistors.         3.       To design amplifier circuits         4.       To design amplifier circuits.         Structure - Equilibrium conditions - Energy Band Concepts - Zero bias - Forward Bias - Reverse bias - Junctio capacitances - one sided and non-uniformly doped junctions - Ideal PN junction current, P-N junction diode, V. characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, voltage regulator using Zener diode clamping and clipping circuits.         UNIT II       TRANSISTORS       9       0       0       9         Physical behaviour of a BJT - Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base common emitter and commo collector configurations, Input and output characteristics, Early effect, regions of operation CA C and DC load lines - Need for stability of Q-Point. Bias stability - Tixed bias, collector to base bias, self bias. Transists switching times-Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid - <i>x</i> mode BJT ratings, Junction field effect transistor - structure, JFET structure and characteristics - UJT - structure and characteristics         UNIT II       SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Differential and Common mode gain with resistive load and active load, CMRR - Cascade and Darlington Amplifiers.         UNIT IV       LARGE SIGNAL AMPLIFIER CIRCUITS       9       0       0       9			Hours / Week	3	0	0	3
2.       To understand the characteristics of transistors.         3.       To design amplifier circuits         4.       To design the oscillator circuits.         UNIT 1       DIODES       9       0       9       0       9       0       9       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       0       0       9       0       0       0       9       0       0       0       0       9       0	Coι	urse Objectives:					
3.       To design amplifier circuits         4.       To design the oscillator circuits.         VUNT I       DIODES       9       0       0       9         Structure – Equilibrium conditions – Energy Band Concepts – Zero bias – Forward Bias – Reverse bias – Junction capacitances – one sided and non-uniformly doped junctions – Ideal PN junction current, P-N junction diode, V-characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, voltage regulator using Zener diode clamping and clipping circuits.         UNIT I       TRANSISTORS       9       0       0       9         Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation - Common basc common emitter and common collector configurations, Input and output characteristics. Early effect, regions of operation AC and DC load lines - Need for stability of Q-Point, Bias stability – fixed bias, collector to base bias, self bias, Transiste BJT ratings, Junction field effect transistor – structure, JFET structure and characteristics - UTI – structure and characteristics         UNIT II       SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       9         Birgle stage BJT and FET amplifiers, Analysis at low, medium and high frequencies – BJT and FET Differential amplifie       9       0       0       9         Oursein of Ficiency, Complementary symmetry power amplifiers, Class AB operation, Class C and Class D amplifiers.       0       0       9       0       0       9         UNIT IV       <	1.	To understand the characteristics of diodes.					
4.       To design the oscillator circuits.         UNT1 I       DIODES       9       0       0       0       9         Structure - Equilibrium conditions - Energy Band Concepts - Zero bias - Forward Bias - Reverse bias - Junctio capacitances - one sided and non-uniformly doped junctions - Ideal PN junction current, P-N junction diode, V-characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, voltage regulator using Zener diode clamping and clipping circuits.         UNIT II       TRANSISTORS       9       0       0       0       9         Physical behaviour of a BJT - Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base common emitter and common collector configurations, Input and output characteristics. Capt effect, regions of operation AC and DC load lines - Need for stability of Q-Point. Bias stability – fixed bias, collector to base bias, self bias. Transisto Switching times-Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid -π mode BJT ratings, Junction field effect transistor - structure, JFET structure and characteristics -UJT- structure and characteristics.         UNIT IV       SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Power amplifiers-       Classification, Single ended and value load, CMRR - Cascade and Darlington Amplifiers.         UNIT IV       LARGE SIGNALA AMPLIFIER CIRCUITS       9       0       0       9         Power amplifiers-       Classification, Single ended and value houth-politon, Class							
UNIT I       DIODES       9       0       0       0       9         Structure – Equilibrium conditions – Energy Band Concepts – Zero bias – Forward Bias – Reverse bias – Junctio capacitances – one sided and non-uniformly doped junctions – Ideal PN junction current, P-N junction diode, V-characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, voltage regulator using Zener diode clamping and clipping circuits.         UNIT II       TRANSISTORS       9       0       0       9         Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base common emitter and common collector configurations, Input and output characteristics. Early effect, regions of operation AC and DC load lines - Need for stability of Q-Point. Bias stability – fixed bias, collector to base bias, self bias. Transisto as witching times-Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid – <i>m</i> mode BJT ratings. Junction field effect transistor – structure, IFET structure and characteristics -UJT- structure and characteristics.         UNIT II       SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Differential and Common mode gain with resistive load and active load, CMRR - Cascade and Darlington Amplifiers.       UNIT IV       LARGE SIGNAL AMPLIFIER CIRCUITS       9       0       0       0       9         Power amplifiers-       Classification, Single ended and Push-pull Configuration, Power dissipation, Output power an Conversion efficiency, Complementary symmetry power amplifiers, Class AB op							
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clamping and clipping circuits.       9       0       0       9         UNIT II       TRANSISTORS       9       0       0       9         Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base common emitter and common collector configurations, Input and output characteristics, Early effect, regions of operatior AC and DC load lines - Need for stability of Q-Point. Bias stability – fixed bias, collector to base bias, self bias. Transists switching times-Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid –π mode BJT ratings, Junction field effect transistor – structure, JFET structure and characteristics -UJT - structure and characteristics         UNIT III       SMALL SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Single stage BJT and FET amplifiers, Analysis at low, medium and high frequencies – BJT and FET Differential amplifie       Differential amplifiers.         UNIT IV       LARGE SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Power amplifiers-       Complementary symmetry power amplifiers, Class AB operation, Class C and Class D amplifiers       Class C and Class D amplifier         UNIT V       FEEDBACK AMPLIFIER SAND OSCILLATORS       9       0       0       9         Advantages of negative feedback – voltage / current, series, Shunt feedback – positive feedback – Condition for oscillation: phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators. <tr< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr<>							
UNIT II       TRANSISTORS       9       0       0       9         Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base common emitter and common collector configurations, Input and output characteristics, Early effect, regions of operation AC and DC load lines - Need for stability of Q-Point. Bias stability – fixed bias, collector to base bias, self bias. Transists switching times - Transistor as a switch and an amplifier, small signal ac model, high frequency effects, hybrid –π mode BJT ratings, Junction field effect transistor – structure, JFET structure and characteristics -UJT - structure and characteristics -UJT - structure and characteristics Differential and Common mode gain with resistive load and active load, CMRR - Cascade and Darlington Amplifiers.         UNIT IV       LARGE SIGNAL AMPLIFIER CIRCUITS       9       0       0       9         Power amplifiers - Classification, Single ended and Push-pull Configuration, Power dissipation, Output power an Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation, Class C and Class D amplifiers thermal considerations.       9       0       0       9         UNIT V       FEEDBACK AMPLIFIERS AND OSCILLATORS       9       0       0       9         Advantages of negative feedback – voltage / current, series, Shunt feedback – positive feedback – Condition for oscillation: phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.       Total (45L + 0T) = 45 Period         Total (45L + 0T) = 45 Period          1       Millm			ters, Zener thoues, vonage regul	ator us	mg Z		nouc
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Cour	se (	Outcomes:	Bloom's Taxonomy
Upon	con	npletion of this course, the students will be able to:	Mapped
CO1	:	Understand overview of semiconductor devices.	L2: Understanding
CO2	:	Recognize the fundamentals and characteristics of BJT	L1: Remembering
CO3	:	Analyze the fundamentals and characteristics of FET and UJT	L2: Understanding
CO4	:	Design and analyze the amplifiers	L4: Analysing
CO5	:	Design and analyze the differential amplifiers	L4: Analysing

23PTCS101	FUNDAMENTAL OF PROBLEM SOLVING C PROGRAMMING	AND	SEM	IEST	ER	Ι
PREREQUIS	SITES	CATEGORY	ES	Cre	edit	3
NIL		Hours / Week	L 3	Т 0	P 0	TH 3
Course Object	ctives:			-	-	-
1. To introdu	uce the problem-solving methodologies.					
2. To learn t	he basic concepts of developing an algorithm and pseudo code.					
3. To unders	stand the concepts of C Programming.				_	
UNIT I IN	NTRODUCTION		9	0	0	9
	of Computers – Evolution of Computers – Computer Generation nization –Number System – Binary – Decimal – Conversion – Pro		of Co	mpute	ers –	Basic
UNIT II P	ROBLEM SOLVING		9	0	0	9
	lation, Problem Solving methods, Need for logical analysis and thi cter set, Identifies and Keywords, Data Types, Declarations, Expre	0 0				Flow
	PROGRAMMING BASICS	1.0	<b>9</b>	0	0	9
Operators – A	PROGRAMMING BASICS rithmetic Operators – Unary operators – Relational and Logic erators. Managing Input and Output operations, pre-processor direct		ssignn	nent c	÷	-
Operators – A Conditional ope	rithmetic Operators – Unary operators – Relational and Logic erators. Managing Input and Output operations, pre-processor direct CONTROL STATEMENTS, ARRAYS AND STRINGS	ctives and storage	Assignm classes 9	nent c	operat	ors – 9
Operators – A Conditional ope UNIT IV C Conditional stat	rithmetic Operators – Unary operators – Relational and Logic erators. Managing Input and Output operations, pre-processor direct	ctives and storage	Assignm classes 9	nent c	operat	ors – 9
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Operators – A         Conditional operators         UNIT IV       C         Conditional stat         dimensional arr         UNIT V       F         Function – Libr	rithmetic Operators – Unary operators – Relational and Logic erators. Managing Input and Output operations, pre-processor direct <b>CONTROL STATEMENTS, ARRAYS AND STRINGS</b> tements-branching and looping statements. Arrays – Initialization –	- Declaration – on S and function defini	ssignm classes 9 e dime 9	onent o	0 al and 0	ors – 9 two- 9
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		Putcomes: appletion of this course, the students will be able to:	Bloom's Taxonomy Mapped
CO1	:	To Understand the basic terminology used in computer programming.	L2: Understanding
CO2	:	To write, compile and debug programs in C language.	L1: Applying
CO3	:	To Use different data types in a computer program	L1: Remembering
CO4	:	To Understand, analyze and implement software development tools like algorithm, pseudocodes and programming structure	L2: Understanding
CO5	:	To write programs related to simple/ moderate mathematical and logical problems in "C".	L1: Applying

23PTMA2	01 MATHEMATICS – II (Common to Part-Time B.E - CIVIL, ECE, EEE & ME	CH branches)	SEMESTER		ER	II
PREREQU		CATEGORY	BS	Cre	dit	3
		<b>TT</b> / <b>TT I</b> -	L	Т	P	TI
Basic 12 <sup>th</sup> le	vel knowledge of Differential Calculus, Integral Calculus and ODE.	Hours / Week	3	0	0	3
Course Ob	ojectives:					
	oduce the concept of Fourier series.					
	lerstand the application of Fourier analysis in solving boundary values					
	tain the knowledge of solving second order ODE using Laplace t orm using convolution theorem.	ransform techniqu	es and	inver	se La	plac
	niliarize with Fourier, transform of a function and its sine and cosine	transforms.				
5. To gai	n the skills to form difference equations and find its solution by using	g Z-transform meth	nod.			
UNIT I	FOURIER SERIES		9	0	0	9
– Parseval's	-		1			
UNIT II	BOUNDARY VALUE PROBLEMS		9	0	0	9
dimensional	on of second order quasi linear partial differential equations – Solution heat equation – Steady state solution of two-dimensional heat eq Fourier series solutions in Cartesian coordinates.					
			T			
					0	6
	LAPLACE TRANSFORM		9	0	v	
Laplace Tra	insform- Conditions for existence - Transform of elementary fund		perties	S - Tr	ansfo	rm
Laplace Tra			perties	S - Tr	ansfo	rm
Laplace Tra derivatives a	insform- Conditions for existence - Transform of elementary fund		perties	S - Tr	ansfo	rm
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		utcomes:	Bloom's Taxonomy
Upon c	om	pletion of this course, the students will be able to:	Mapped
CO1	:	Acquire the knowledge about Fourier series.	L2: Understanding
CO2	:	Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.	L3: Applying
CO3	:	Apply the knowledge of Laplace transforms method to solve second order differential equations.	L3: Applying
CO4	:	Apply the knowledge of Fourier transform in engineering problems.	L3: Applying
CO5	:	Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.	L3: Applying

<b>23PTEE20</b>	1 ELECTROMAGNETIC THEORY		SEM	IEST	ER	II
PREREQU	JISITES	CATEGORY	PC	Cre	edit	3
Basic Electri	cal and Electronics Engineering	Hours / Week	L	Т	Р	TH
Busic Electri			2	1	0	3
Course Ob	jectives:					
	owledge on the basic concepts of vectors, coordinate systems, stat			nd mag	gnetic	fields
and apply M	axwell's equations for various engineering applications involving of	electromagnetic way	ves.			
UNIT I	ELECTROSTATICS – I		6	3	0	9
	s: Components of a vector and Classification of vector fields -	Coordinate System	ns and	-	forma	
	vergence, Curl - theorems and applications - Coulomb's Law - E	lectric field intensit	ty – Fie	eld due	e to di	iscrete
and continuo	us charges – Gauss's law and applications.					
UNIT II	ELECTROSTATICS – II		6	3	0	9
	density – Electric potential – Electric dipole – Electric field in fre	e space conductors	-	-	v	-
	Dielectric strength- Electric field in multiple dielectrics Bou					
	apacitance, Energy density, Applications.	indury contantionis, i	1 010001	i b uii	a Dap	iuce s
•						
UNIT III	MAGNETOSTATICS		6	3	0	9
Lorentz force	e, magnetic field intensity (H) - Biot-Savart's Law - Ampere's G	Circuit Law – H du	e to str	aight	condu	ictors
circular loop.	, infinite sheet of current, Magnetic flux density (B) - B in free spac	e, conductor, magne	etic mat	terials	–Ma	gnetio
	ector potential - Magnetic force, Torque and Moment - Magneti	zation, Magnetic fi			ole m	edia -
	ector potential - Magnetic force, Torque and Moment - Magneti nditions, Poisson's Equation, Inductance, Energy density, Applica				ple m	edia -
	ector potential - Magnetic force, Torque and Moment - Magneti nditions, Poisson's Equation, Inductance, Energy density, Applica				ole m	edia –
Boundary co	nditions, Poisson's Equation, Inductance, Energy density, Applica ELECTRODYNAMIC FIELDS	tions.	ield in	multij 3	0	9
Boundary co UNIT IV Magnetic Ci	nditions, Poisson's Equation, Inductance, Energy density, Applica ELECTRODYNAMIC FIELDS rcuits - Faraday's law – Transformer and motional EMF – Di	tions.	ield in 6 t - Max	multij 3 xwell'	0 s equ	9 ations
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Cour	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Recognize the fundamental concept, laws and theorem of electric and magnetic fields.	L1: Remembering
CO2	:	Review the concepts in electrostatic fields and magnetic fields.	L2: Understanding
CO3	:	Analyze the Electric and magnetic Field in material space.	L4: Analysing
CO4	:	Apply the boundary conditions to the applications in electrostatic fields and magnetostatic fields.	L3: Applying
CO5	:	Assess the knowledge of electromagnetic waves and characterizing parameters.	L4: Analysing

<b>23PTEE20</b> 2	2 SYNCHRONOUS AND INDUCTION MACHINES	SI	EM	IEST	ER	II
PREREQU	ISITES CATEGOR	Y P	С	Cre	edit	3
		, L	1	Т	Р	TH
Electrical Ma	chines Hours / Wee	K 2		1	0	3
Course Obj	jectives:					
	provides understanding of AC machinery fundamentals, machine parts and help machines and equips students to analyse the equivalent circuits of Induction and					
UNIT I	ALTERNATOR	6		3	0	9
Synchronous	, types, practical rating of synchronous generators, winding factors, production of reactance, phasor diagram, Methods of pre-determination of voltage regulation Potier triangle methods. Two reaction theory–Slip test, synchronization -Change of the	- Sync	hro	nous	impe	dance,
UNIT II	SYNCHRONOUS MOTOR	6		3	0	9
	eration–phasor diagrams, Torque equation – Operation on infinite bus bars, var	-				-
	acitation. Hunting and its suppression, V and inverted V curves, Synchronous cond					
UNIT III	THREE PHASE INDUCTION MACHINES	6		3	0	9
		-				-
	al details, types, production of rotating magnetic field-principle of operation and	oractica	l ra	ating (	of ind	uction
	al details, types, production of rotating magnetic field-principle of operation and for starting – Types of starters – DOL. Rotor resistance and Auto transformer star					
motors. Need	for starting – Types of starters – DOL, Rotor resistance and Auto transformer star					
motors. Need						
motors. Need	for starting – Types of starters – DOL, Rotor resistance and Auto transformer star	ters. G	ene			
motors. Need excitation, op UNIT IV Phasor diagra output, Torq	for starting – Types of starters – DOL, Rotor resistance and Auto transformer star beration, and applications. ANALYSIS AND TESTING OF THREE PHASE INDUCTIO	N 6	ene	rator 3 ip for	action 0	9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
motors. Need excitation, op <b>UNIT IV</b> Phasor diagra output, Torq parameters, c	for starting – Types of starters – DOL, Rotor resistance and Auto transformer star- beration, and applications. ANALYSIS AND TESTING OF THREE PHASE INDUCTIO MOTORS am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot ircle diagram.	N 6	ene , sli β- ε	a ip for equiva	action 0	9 imum- circuit
motors. Need excitation, op UNIT IV Phasor diagra output, Torq parameters, c UNIT V Constructiona	If for starting – Types of starters – DOL, Rotor resistance and Auto transformer starteration, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTIO         MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum         ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot	N 6 output or tests 6 ation –	ene , sli S- e Eq	rator 3 ip for equiva 3 juival	o o r maxi alent o lent ci	9 imum- circuit 9 rcuit –
motors. Need excitation, op UNIT IV Phasor diagra output, Torqp parameters, c UNIT V Constructiona Starting meth	If for starting – Types of starters – DOL, Rotor resistance and Auto transformer starteration, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot ircle diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in , and Shaded pole - Applications.	N 6 -output or tests ation – luction	ene , sli S- e Eq rui	3 ip for equiva 3 juival n, Ca	0 maxialent 0 lent ci pacito	9 mum- circuit 9 rcuit – or-start
motors. Need excitation, op UNIT IV Phasor diagra output, Torqp parameters, c UNIT V Constructiona Starting meth	If for starting – Types of starters – DOL, Rotor resistance and Auto transformer starteration, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTIO         MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum         ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot         ircle diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope         nods of single-phase induction motors – Types: Split phase, Capacitor start – in	N 6 -output or tests ation – luction	ene , sli S- e Eq rui	3 ip for equiva 3 juival n, Ca	0 maxialent 0 lent ci pacito	9 mum- circuit 9 rcuit – or-start
motors. Need excitation, op UNIT IV Phasor diagra output, Torqp parameters, c UNIT V Constructiona Starting meth	If for starting – Types of starters – DOL, Rotor resistance and Auto transformer starteration, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot ircle diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in , and Shaded pole - Applications.	N 6 -output or tests ation – luction	ene , sli S- e Eq rui	3 ip for equiva 3 juival n, Ca	0 maxialent 0 lent ci pacito	9 mum- circuit 9 rcuit – or-start
motors. Need excitation, op UNIT IV Phasor diagra output, Torq parameters, c UNIT V Constructiona Starting meth capacitor run	If for starting – Types of starters – DOL, Rotor resistance and Auto transformer starteration, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot ircle diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in , and Shaded pole - Applications.	N 6 output or tests 6 ation – luction	ene , sli 5- e rui <b>15</b> 7	rator 3 ip for equiva $\overline{3}$ quival n, Ca $\Gamma) = 0$	0 0 1 maxi alent lent ci pacito 45 Pe	9 mum- circuit 9 rcuit – or-start priods
motors. Need excitation, op UNIT IV Phasor diagra output, Torqu parameters, c UNIT V Constructiona Starting meth capacitor run Text Books 1. D.P. K 2. Dr.P.S	If or starting – Types of starters – DOL, Rotor resistance and Auto transformer starberation, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked roticel diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in , and Shaded pole - Applications.         Total (as the start of the start o	N 6 output or tests ation – luction 60L +	ene , sli - Eq rui 157	rator 3 ip for equivation, Ca $\Gamma$ ) = $c$ New 1	0 r maxialent 0 lent ci pacito 45 Pe	self- 9 mum- circuit 9 rcuit – or-start eriods
motors. Need excitation, op UNIT IV Phasor diagra output, Torq parameters, c UNIT V Constructiona Starting meth capacitor run Text Books 1. D.P. K 2. Dr.P.S 3 A.E. F	If or starting – Types of starters – DOL, Rotor resistance and Auto transformer starberation, and applications.         ANALYSIS AND TESTING OF THREE PHASE INDUCTION MOTORS         am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked roticicle diagram.         SINGLE PHASE INDUCTION MOTOR         al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in, and Shaded pole - Applications.         Total (and Start, and I. J. Nagrath, "Electric Machines", 4th edition, Tata McGraw-Hill Com	N 6 output or tests ation – luction 60L +	ene , sli - Eq rui 157	rator 3 ip for equivation, Ca $\Gamma$ ) = $c$ New 1	0 r maxialent 0 lent ci pacito 45 Pe	self- 9 mum- circuit 9 rcuit – or-start eriods
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motors. Need excitation, op UNIT IV Phasor diagra output, Torq parameters, c UNIT V Constructiona Starting meth capacitor run Text Books 1. D.P. K 2. Dr.P.S 3. A.E. F Comp References	ANALYSIS AND TESTING OF THREE PHASE INDUCTIO MOTORS am, equivalent circuit, Torque equation-starting and maximum-torque, maximum ue-slip characteristics, losses, and efficiency. Testing-no load and blocked rot ircle diagram. SINGLE PHASE INDUCTION MOTOR al details of single-phase induction motor – Double field revolving theory and ope nods of single-phase induction motors – Types: Split phase, Capacitor start – in , and Shaded pole - Applications. Total ( Cothari, and I. J. Nagrath, "Electric Machines", 4th edition, Tata McGraw-Hill Com B. Bimbhra, "Electrical Machinery", Khanna Publishers, Delhi, 2007. Fitzgerald, Charles Kingsley and Stephen. D. Umans, "Electric Machinery", Ta any Ltd, 2015.	N 6 -output or tests duction – luction BOL + a McG	ene , sli 3- e rui <b>15</b> 7	rator 3 ip for equivation <b>3</b> <b>1</b> <b>3</b> <b>1</b> <b>1</b> <b>1</b> <b>3</b> <b>1</b> <b>3</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>3</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	0 r maxialent 0 lent ci pacito 45 Pe Delhi,	s: self- 9 imum- circuit 9 rcuit – or-start eriods 2010. ishing

Cours	e C	outcomes:	
Upon c	om	pletion of this course, the students will be able to:	Bloom's Taxonomy Mapped
CO1	:	Familiarize with construction, working principle, synchronizing techniques and performance of Synchronous Generator.	L1: Remembering
CO2	:	Understand the working principle, torque equation, and excitation control for Synchronous Motor.	L2: Understanding
CO3	:	Operate three phase Induction machine as motor and as a generator.	L4: Analysing
CO4	:	Analyse the performance of three phase induction motor with testing.	L4: Analysing
CO5	:	Know double field revolving theory and starting mechanisms for single-phase induction motors	L5: Evaluating

	TEE203 ANALOG AND DIGITAL INTEGRATED C	IRCUITS	SEN	1EST	TER	II
PR	EREQUISITES	CATEGORY	PC	Cr	edit	3
Elec	tron Devices and Circuits	Hours / Week	L 3	T 0	P 0	TH 3
0						
	urse Objectives:	1101 0 1 1 1	•			
1.	To impart knowledge on the characteristics& applications of Operation Art of linear ICs	nplifier, functional d	lagram	ı & ap	plicat	ions
2.	To simplify the switching functions					
3.	To design the combinational logic circuits and sequential logic circuits					
UN	IT I OPERATIONAL AMPLIFIERS		9	0	0	9
Volt Outj off s	rational amplifiers - Equivalent circuit, voltage transfer curve - Open loc tage shunt feedback amplifiers configurations, closed loop differential ampli- put offset voltage, minimizing output offset voltage due to input bias current set parameters, CMRR - Open loop and closed loop frequency response of cts in applications.	ifiers for single and nt and input offset c	differe urrent,	ntial of factor	output rs affe	s. ecting
UN	IT II APPLICATION OF OPERATIONAL AMPLIFIER AN	D LINFAR ICS	9	0	0	9
for t Cross Acti filte Fund	& AC amplifiers- Summing, Scaling and Averaging Amplifiers-Instrumenta floating and grounded loads - Current to voltage converter - Integrator, ssing Detector - Schmitt trigger with voltage limiter- Precision Rectifier Circ ve Filters - Frequency response characteristics of major active filters, firs rs, all pass filters. ctional block diagram and Applications of Linear ICs: IC 555 Timer -IC se-locked loops - IC LM317 voltage regulators.	Differentiator. Volta uits-Peak Detector-S at and higher order 1	age con Sample low pa	npara and H ss and	tors - Iold ci 1 high	Zero ircuit, pass
UN	IT III COMBINATIONAL LOGIC CIRCUITS		9	0	0	9
	resentation of logic functions: SOP and POS forms - Simplification of swit	ching functions: K-r	naps m	ethod	and (	Quine
	Cluskey (Tabulation) method.					
	ign: Adders -Subtractors– 2-bit Magnitude Comparator-Multiplexer- De oder – Code Converters. Implementation of combinational logic circuits usi				Enco	oder -
Dee	Code Converters, implementation of combinational logic circuits as	ing multiplexers and	Decod			
UN	IT IV SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS		9	0	0	9
	-flops: SR, D, JK and T- Conversion of flip-flops; Classification of sequ lysis and design of synchronous sequential circuits - Design of synchronous					dels -
	IT V ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS					~
UN			9	0	0	9
Fun prin	damental mode and pulse mode circuits, Analysis procedure of asynchronou nitive state / flow table – Reduction of state and flow table - state assignment //without using of SR latches-Problems in asynchronous sequential circuits	s circuits with /with –Design Procedure of	out usi of asyn	ng of	SR lat	ches-
Fun prin	hitive state / flow table – Reduction of state and flow table - state assignment	s circuits with /with –Design Procedure of	out usin of asyn zards.	ng of chron	SR lat ous ci	ches- rcuits
Fund prim with	hitive state / flow table – Reduction of state and flow table - state assignment /without using of SR latches-Problems in asynchronous sequential circuits t Books:	s circuits with /with –Design Procedure of : cycles -Races –Haz <b>Total (45</b> )	out using of asyn zards.	ng of chron $\Gamma = 4$	SR lat ous ci	ches- rcuits
Fund prim with	hitive state / flow table – Reduction of state and flow table - state assignment /without using of SR latches-Problems in asynchronous sequential circuits <b>t Books:</b> Ramakant A Gayakward, "Op-Amps and Linear Integrated Circuits", Fou	s circuits with /with –Design Procedure of : cycles -Races –Haz <b>Total (45</b> ) rth Edition, Pearson	out usi: of asyn zards. L + 01 Educa	ng of chron $\Gamma$ ) = 4 tion, 2	SR lat ous ci <b>15 Pe</b> 2003.	ches- rcuits riods
Fund print with	<ul> <li>hitive state / flow table – Reduction of state and flow table - state assignment</li> <li>/without using of SR latches-Problems in asynchronous sequential circuits</li> <li>t Books:</li> <li>Ramakant A Gayakward, "Op-Amps and Linear Integrated Circuits", Fou Donald.E.Neaman, "Electronic Circuit, Analysis and Design", Tata M Second Edition, 2002.</li> </ul>	s circuits with /with –Design Procedure of : cycles -Races –Haz <b>Total (45</b> ) rth Edition, Pearson cGraw Hill Publish	out using $L + 0$ Education $L + 0$	ng of chron $\Gamma) = 4$ tion, 2 ompar	SR lat ous ci IS Per 2003. ny Lir	ches- rcuits riods nited,
Fund prim with Tex 1.	<ul> <li>hitive state / flow table – Reduction of state and flow table - state assignment //without using of SR latches-Problems in asynchronous sequential circuits</li> <li>t Books:</li> <li>Ramakant A Gayakward, "Op-Amps and Linear Integrated Circuits", Fou Donald.E.Neaman, "Electronic Circuit, Analysis and Design", Tata M Second Edition, 2002.</li> <li>D.Roy Chowdhury and Shail B. Jain, "Linear Integrated Circuits", Four Publishers, 2014.</li> </ul>	s circuits with /with -Design Procedure of : cycles -Races -Haz <b>Total (45)</b> rth Edition, Pearson cGraw Hill Publish th Edition, New Ag	L + 0 Educa ing Co	ng of chron $\Gamma) = 4$ tion, 2 ompar	SR lat ous ci IS Pe 2003. ny Lir nal (P	ches- rcuits riods nited, ) Ltd
Fund print with Tex 1. 2.	<ul> <li>hitive state / flow table – Reduction of state and flow table - state assignment</li> <li>/without using of SR latches-Problems in asynchronous sequential circuits</li> <li>t Books:</li> <li>Ramakant A Gayakward, "Op-Amps and Linear Integrated Circuits", Fou</li> <li>Donald.E.Neaman, "Electronic Circuit, Analysis and Design", Tata M</li> <li>Second Edition, 2002.</li> <li>D.Roy Chowdhury and Shail B. Jain, "Linear Integrated Circuits", Fou</li> </ul>	Is circuits with /with -Design Procedure of : cycles -Races -Haz Total (45) rth Edition, Pearson cGraw Hill Publish th Edition, New Ag dia Pvt. Ltd., New	L + 0 Educa ing Cc ge Inter Delhi,	ng of chron $\Gamma) = 4$ tion, 2 ompar matio 2003	SR lat ous ci IS Per 2003. ny Lir nal (P	rcuits riods nited, ) Ltd arson

Ref	erence Books:
1	Jacob Millman, and Christos C. Halkias, "Integrated Electronics- Analog and Digital circuits system", Tata McGraw
1.	Hill 2003.
n	R.P.Jain, "Modern Digital Electronics", Third Edition, Tata McGraw-Hill Publishing company limited, New Delhi,
۷.	2011.
3.	Thomas L. Floyd, "Digital Fundamentals", Pearson Education, Inc, New Delhi, 2015
4	Donald P. Leach and Albert Paul Malvino, "Digital Principles and Applications", Fifth Edition, Tata McGraw Hill
4.	Publishing Company Limited, New Delhi, 2012.

Cours	Course Outcomes:		Bloom's Taxonomy
Upon c	omp	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the Op-amp characteristics	L2: Understanding
CO2	:	Understand the applications of Op-amp and other linear ICs.	L2: Understanding
CO3	:	Apply K-map and tabulation methods to simplify the switching functions	L3: Applying
CO4	:	Design and implement of combinational logic circuits	L6: Creating
CO5	:	Analyse and design of synchronous & asynchronous sequential logic circuits	L4: Analyzing

23P	TEE204 ELECTRICAL MACHINES LABORATO	DRY	SEM	EST	ER	II
PRE	REQUISITES	CATEGORY	PC	Cre	edit	1.5
NIL		Hours / Week	L	Т	Р	TH
1,122			0	0	3	3
Cou	rse Objectives:					
1.	To expose the students to operate of DC and AC Machines and strength th	eir experimental sk	till.			
Eve	nimente					
<u>ехр</u> е 1.	eriments Open circuit and load characteristics of DC shunt generator.					
1.	open encan and total characteristics of De shant generator.					
2.	Load characteristics of DC long shunt and short shunt compound ge connections.	nerator with cum	ılative	and	differ	ential
3.	Load test on DC series motor.					
4.	Swinburne's test on DC machines.					
5.	Speed control of DC shunt motor.					
6.	Open circuit and short circuit tests on single phase transformer.					
7.	Load test on single-phase transformer / three phase transformer.					
8.	Predetermination of Voltage Regulation of three-phase alternator by EMF	and MMF methods	5.			
9.	V and inverted V curves of synchronous motor.					
10.	Circle diagram for three phase induction motor with no load and blocked r	otor test data.				
11.	Load test on three-phase induction motor/single phase induction motor.					
12.	Separation of losses in three phase induction motor.					
		Total (0	+ 45P	) = 4	5 Pei	riods
Refe	rence Books:					
1.	G.P. Chhalotra, "Experiments in Electrical Engineering", 3 <sup>rd</sup> Ed., Khanna	Publishers, Delhi, 2	2004.			
2.	C.S. Indulkar, "Laboratory Experiments in Electrical Power", 3rd Ed., Kha			0.		
3.	DC machines and transformers laboratory manual prepared by the department					
4.	Synchronous and Induction Machines manual prepared by the department.					

Cour Upon		Bloom's Taxonomy Mapped	
CO1	:	Understand the voltage regulation of a given alternator using different methodologies and Transformer	L2: Understanding
CO2	:	Analyze the performance of a given synchronous motor under various excitation. Conditions	L4: Analyzing
CO3	:	Analyze the characteristics of a induction motor and DC machines under various load conditions	L4: Analyzing
CO4	:	Develop the equivalent circuit and analyze the characteristics of AC machine	L5: Creating
CO5	:	Do loss analysis in DC and AC machines.	L4: Analyzing

	PTEE301	CONTROL SYSTEMS		SEM	EST	ER	III
PR	EREQU	ISITES	CATEGORY	PC	Cre	edit	3
Ele	ctrical Ma	chines and Electric circuit Analysis	Hours / Week	L	Τ	Р	TH
				2	1	0	3
Co	urse Obj	ectives:					
1.	To under	rstand the methods of representation of Physical systems and gett	ing their transfer fu	unction	mode	ls.	
2.	_	de adequate knowledge in the time response of systems and stead	· · · · · ·				
3.	-	basic knowledge in obtaining the open loop and closed loop frequ	· · ·	ystems.			
4.		rstand the concept of stability of control system and methods of s					
5.	To study	the three ways of designing compensators for a Feedback control	l system.				
TIN	тт т	MODELING OF LINEAD TIME INVADIANT SYC	TENA		2	0	0
		MODELING OF LINEAR TIME INVARIANT SYS		6	3	0	9
		s in control systems – Open and closed loop systems – Feedback c	•				
		ectrical analogy of mechanical systems – Transfer function Rep	resentation - Sync	hro – A	C and	a DC	servo
mo	tors - Bloc	k diagram reduction techniques – Signal flow graphs.					
TIN	IIT II	TIME RESPONSE ANALYSIS		6	3	0	9
		signals – Time response of first order and second order systems -	Time demain and		_	-	-
		• • • •	-				
		or constants - Type and order of control systems - Effect of ad	ding poles and zer	os to tra	anster	funct	ions
Res	sponse with	h P, PI, PD and PID controllers.					
UN	III TII						
U		FREQUENCY RESPONSE ANALYSIS		6	3	0	9
		FREQUENCY RESPONSE ANALYSIS etween time and frequency response: Second order systems - Free	quency domain spe	-	-	~	
Cor	rrelation be			cificatio	ons – l	~	
Cor	rrelation be	etween time and frequency response: Second order systems - Free		cificatio	ons – l	~	
Cor Boo	rrelation be	etween time and frequency response: Second order systems - Free		cificatio	ons – l	~	plots
Cor Boo	rrelation be de plots – ( NIT IV	etween time and frequency response: Second order systems - Free Computation of Gain Margin and Phase Margin – Constant M and	1 N-circles – Nicho	cification ols chart	ons – 1	Polar j 0	plots 9
Con Boo UN BIE	rrelation be de plots – ( NIT IV 30 stability	etween time and frequency response: Second order systems - Free Computation of Gain Margin and Phase Margin – Constant M and STABILITY OF CONTROL SYSTEM	l N-circles – Nicho	cification ols chart 6 s conce	ons – ]	Polar j 0 Rules :	plots 9
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E-F	E-References:					
1.	https://nptel.ac.in/courses/107106081					
2.	https://nptel.ac.in/courses/108106098					

Cours	Course Outcomes:		
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Develop the transfer function models of any electrical and electro-mechanical systems.	L2: Understanding
CO2	:	Obtain the time responses of the systems and construct root locus plot.	L3: Applying
CO3	:	Analyze the frequency response of the system	L3: Applying
CO4	:	Analyze the absolute / relative stability of a control system.	L4: Analyzing
CO5	:	Design the compensators and PID controller of a feedback control system.	L3: Applying

23PTEE302	POWER ELECTRONICS		SE	MEST	ER	III
PREREQU	ISITES	CATEGORY	PC	Cr	edit	3
Electron Devi	ces and Circuits	Hours / Week	L	T	P	TH
			3	0	0	3
Course Obj	ectives:					
1. To study	an overview of power semiconductor devices.					
2. To obtain	n the knowledge of controlled rectifiers.					
3. To acqui	re the principles of DC-DC converter.					
4. To under	rstand the principles of inverters and ac voltage controllers.					
UNIT I	POWER SEMICONDUCTOR DEVICES		9	0	0	9
Concept of po	wer electronics- Structure, Operation, Static and Switching cha	racteristics of powe	er semi	iconduc	ctor de	vices:
Power Diode,	SCR, MOSFET, IGBT- Thyristor ratings and protection, Ga	te drive circuits for	or MO	SFET	and IC	GBT -
Switching and	Conduction losses in a generic power semiconductor device.					
UNIT II	PHASE CONTROLLED RECTIFIERS		9	0	0	9
	and three phase fully controlled rectifiers: Power circuit, Ope	ration Waveform	-		Ŷ	-
	Effect of source inductance for Single phase and Three phase full		•	-	-	
phase dual con	• • • •	, controlled lectille	i Ding	Sie plia	se una	Thee
-						
UNIT III	DC TO DC CONVERTER		9	0	0	9
		nd average voltage			•	-
Elementary ch	DC TO DC CONVERTER		– conti	rol strat	tegy –l	Power
Elementary ch Circuit and ste	DC TO DC CONVERTER nopper with an active switch and diode, concepts of duty ratio a		– conti	rol strat	tegy –l	Power
Elementary ch Circuit and ste of inductor an	<b>DC TO DC CONVERTER</b> nopper with an active switch and diode, concepts of duty ratio a eady state analysis of Buck converter, Boost converter, Buck – b d capacitors for DC-DC converters.		– contr SEPIC	col strat	tegy –l erter- D	Power Design
Elementary ch Circuit and ste of inductor an <b>UNIT IV</b>	DC TO DC CONVERTER         nopper with an active switch and diode, concepts of duty ratio a         eady state analysis of Buck converter, Boost converter, Buck – b         d capacitors for DC-DC converters.         INVERTERS	boost converter and	– contr SEPIC 9	col strat C conve	tegy –l erter- D	Power Design
Elementary cl Circuit and sta of inductor an <b>UNIT IV</b> Power circuit	DC TO DC CONVERTER         nopper with an active switch and diode, concepts of duty ratio a         eady state analysis of Buck converter, Boost converter, Buck – b         d capacitors for DC-DC converters.         INVERTERS         of single phase voltage source inverter, square wave operation of	f the inverter, bipol	– contr SEPIC 9 ar and	col strat C conve 0 unipola	tegy –l erter- D 0 ar sinu:	Power Design 9 soidal
Elementary cl Circuit and ste of inductor an <b>UNIT IV</b> Power circuit modulation, n	DC TO DC CONVERTER         nopper with an active switch and diode, concepts of duty ratio a         eady state analysis of Buck converter, Boost converter, Buck – b         d capacitors for DC-DC converters.         INVERTERS         of single phase voltage source inverter, square wave operation o         nodulation index and output voltage, Power circuit of a three-p	f the inverter, bipol	– contr SEPIC 9 ar and e inver	ol strat C conve 0 unipola rter, op	tegy –l erter- D 0 ar sinu:	Power Design 9 soidal
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Elementary cl Circuit and sta of inductor an UNIT IV Power circuit modulation, n three-phase si UNIT V Introduction a control –Appl	DC TO DC CONVERTER         nopper with an active switch and diode, concepts of duty ratio a         eady state analysis of Buck converter, Boost converter, Buck – b         d capacitors for DC-DC converters.         INVERTERS         of single phase voltage source inverter, square wave operation on nodulation index and output voltage, Power circuit of a three-p         nusoidal modulation – Single phase Auto sequential Commutate         AC TO AC CONVERTERS         and principle of operation of Single phase and Three phase Auto ications of AC Voltage Controllers–Introduction to Matrix conv	f the inverter, bipol ohase voltage source d Current Source Ir C voltage controlle erters. Total (4	- contr SEPIC 9 ar and e inver verter 9 rrs - M	o       strat       conve       unipola       ter, op       .       0       fultista       0T) =	0       ar sinu:       eration       0       ge seq       45 Pe	Power Design 9 soidal 1 with 9 uence riods
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Elementary cl Circuit and sta of inductor an <b>UNIT IV</b> Power circuit modulation, n three-phase si <b>UNIT V</b> Introduction a control –Appl <b>Text Books:</b> 1. M.H.Ras 2017. 2. P.S.Bim <b>Reference B</b>	DC TO DC CONVERTER         hopper with an active switch and diode, concepts of duty ratio a         eady state analysis of Buck converter, Boost converter, Buck – b         d capacitors for DC-DC converters.         INVERTERS         of single phase voltage source inverter, square wave operation on adulation index and output voltage, Power circuit of a three-provided modulation – Single phase Auto sequential Commutate         AC TO AC CONVERTERS         und principle of operation of Single phase and Three phase Arications of AC Voltage Controllers–Introduction to Matrix converted is a converter in the phase of the phase is and the phase is a converter of the phase Arications of AC Voltage Controllers–Introduction to Matrix converted is a converted in the phase converted in the phase is a converted in the phase is	boost converter and f the inverter, bipol ohase voltage source d Current Source Ir C voltage controlle erters. <b>Total (4</b> earson Education, F	- contr SEPIC 9 ar and e inverter verter 9 rs – M 5L +	<b>0</b> unipola         ter, op         0         1ultista <b>0T) =</b> Edition	0 ar sinu: eratior ge seq 45 Pe	Power Design 9 soidal 1 with 9 uence riods
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E-F	E-References:				
1	www.onlinecourses.nptel.ac.in/				
2	www.class-central.com				

Cour		Bloom's Taxonomy	
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Choose suitable Power Semiconductor Device for the power conversion.	L3: Applying
CO2	:	Know the operation of converters, inverters and AC voltage controllers.	L2: Understanding
CO3	:	Analyse the performance of converters and inverters.	L4: Analyzing
CO4	:	Design converter and inverter circuits.	L3: Applying
CO5	:	Identify suitable control techniques for the converter.	L1: Remembering

23P	TEE3(	3 ELECTRICAL MACHINE DESIGN	I	SEN	IEST	'ER	III
PRE	EREQ	JISITES	CATEGORY	PC	Cr	edit	3
	1.1.		Houng / Wools	L	Т	P	TH
DCN	Vlachin	es and Transformers, Synchronous and Induction Machines	Hours / Week	2	1	0	3
Соц	rse Ol	jectives:					
			-1				
1.		tudy mmf calculation and thermal rating of various types of electric	al machines				
2.		Design armature and field systems for D.C. machines.					
3.		besign core, yoke, windings and cooling systems of transformers.					
4.		besign stator and rotor of induction machines.					
5.	To I	besign stator and rotor of synchronous machines and study their the	mal behavior				
					1	·	
UNI		INTRODUCTION		6	3	0	9
-		derations – Limitations – Electrical Engineering Materials – Space	-	-			
		for Air gap and Teeth - Iron losses and Magnetizing current calc	ulations. Design of	f lap w	vindir	ig and	wave
wind	ling - S	andard specification.					
					1		
	TI	DC MACHINES		6	3	0	9
	0	tating machines – D.C machines output equations – Main dimensior	-				0
Load	ling -Se	lection of number of poles – Armature design – Design of commuta	tor and brushes-De	sign of	slot,	air gap	o, field
coils	•						
					-		
UNI	T III	TRANSFORMERS		6	3	0	9
		for single and three phase transformers – Window space factor – $Ov$					
-Reg	gulatio	- No load current - Temperature rise of Transformers- Design of T	ank with & without	coolin	g tube	es – Tl	nermal
rating	g – Me	hods of cooling of Transformers – Design of inductors.					
UNI	T IV	INDUCTION MOTORS		6	3	0	9
Outp	ut equa	tion of Induction motor - Main dimensions - Choice of electrical and	magnetic loadings	Lengt	h of a	ir gap-	Rules
for se	electing	rotor slots of squirrel cage machines- Design of rotor bars & slot	s – Design of end 1	ings –	Desig	gn of '	wound
rotor	-Opera	ing characteristics – Short circuit current – Circle diagram.					
UNI	ΤV	SYNCHRONOUS MOTORS		6	3	0	9
Runa	away sp	eed – construction – output equations – choice of loadings – Desigr	of salient pole ma	chines	- Sho	ort circ	uit ratio
– sha	pe of p	ole face – Armature design – Armature parameters – Estimation of	air gap length– Des	ign of	rotor	–Desi	gn of
damp	per win	ling – Determination of full load field mmf – Design of field windin	ng – Computer Pr	ogram	- des	ign of	Stator
main	dimen	sions					
			Total (30I	J + 15	<b>T</b> ) =	45 Pe	eriods
			× *		/		
Text	t Book	S:					
1.		awhney, "A Course in Electrical Machine Design", 6th edition, Dha	anpat Rai & Sons. I	New D	elhi. 2	2014.	
		en, "Principles of Electrical Machine Designs with Computer Progr	=				Co Pu
		ewDelhi,2009.		a ibii	1 401	usinng	CO. 1 V
		Books:					
			ong Nou Dalh: 2	014			
1.	к.к.А	garwal, Principles of Electrical Machine Design, S.K. Kataria and S	ouis, new Deini 2	014.			

2.	V.N. Mittle, "Design of Electrical Machines", 5 <sup>th</sup> edition, Standard Publications and Distributors, New Delhi, 2013.
3.	V.Rajini, and V.S Nagarajan, "Electrical Machine Design", Pearson, first edition 2018.
DD	

# **E-Reference:**

1. http://cusp.umn.edu/machine\_design.php

Cours	Course Outcomes:		
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Classify the materials used for the construction of electrical machines and be able to calculate the MMF in magnetic parts of rotating machines.	L4: Analyzing
CO2	:	Familiarize the importance of magnetic, thermal, and electrical loading of AC and DC Machines.	L2: Understanding
CO3	:	Design and Analyze Armature and Field Systems for DC Machines.	L4: Analyzing
CO4	:	Design and Analyze core, windings and cooling system of transformers.	L4: Analyzing
CO5	:	Design and analyze Stator and rotor of Induction Machines and Synchronous machines.	L4: Analyzing

PP	PTEE304	MEASUREMENTS AND INSTRUMENTA	ΓΙΟΝ	SEM	EST	ER	III
1 1/	EREQU	ISITES	CATEGORY	PC	Cre	edit	3
Elec	etric Circu	it Analysis	Hours / Week	L 3	Т 0	P 0	TH 3
Coi	urse Obj	ectives:			Ū	Ū	-
1.	To educ	ate the fundamental concepts and characteristics of measurement S	System				
2.		duce the fundamentals of electrical and electronic instruments for n	-	ctrical a	nd No	n-ele	ctrical
	quantitie	es					
3.	To fami	liarize Oscilloscope and the bridge circuits for electrical parameter	s measurement				
UN	IT I	INTRODUCTION		9	0	0	9
		generalized measurement system - Static and dynamic characteris		asureme	nt. M	easur	ement
of v	oltage and	d current - permanent magnet moving coil and moving iron type m	eters				
				C			
	IT II	<b>MEASUREMENT OF POWER, ENERGY AND FREQ</b> of power - single and three phase- electrodynamometer type wath		9	0	0	9
		ter-Electrical resonance type frequency meter					
UN	IT III	DC AND AC BRIDGES		9	0	0	9
	-	tions - Wheatstone bridge – Kelvin double Bridge –Maxwell's inc bridge – Schering bridge and De Sauty's bridge	luctance capacitanc	ce bridg	je – H	lay's l	oridge
UN	IT IV	POTENTIOMETERS, OSCILLOSCOPES AND DIGITINSTRUMENTS	ΓAL	9	0	0	9
DC	Potention	enter Crementer's Determiner AC 4 4 - D 11	1	~			
		neter- Crompton's Potentiometer, AC potentiometer- Drysdale po	-		•		
type	e potention	meter- Crompton's Potentiometer, AC potentiometer– Drysdale po meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters.	-		•		
type Digi	e potention	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope	e-Construction, ope		•		
type Digi UN Clas	e potention ital multi- IT V ssification	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters.	e-Construction, ope	eration a	nd A	pplica	ntions,
type Digi UN Clas	e potention ital multi- IT V ssification	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. MEASUREMENT OF NON-ELECTRICAL QUANTIT of transducers –Position transducers, Piezo-electric transducers and	e-Construction, ope	9 ducers.	<b>0</b> Meas	pplica 0 uremo	9 ent of
type Digi UN Class pres	e potention ital multi- ITT V ssification ssure, temp	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. MEASUREMENT OF NON-ELECTRICAL QUANTIT of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors	E-Construction, ope	9 ducers.	<b>0</b> Meas	pplica 0 uremo	9 ent of
type Digi UN Clas pres	e potention ital multi- IT V ssification ssure, temp	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. MEASUREMENT OF NON-ELECTRICAL QUANTIT of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors	TIES Id Hall effect transo Total (45	9 Jucers.	$0$ Meas $\Gamma = 4$	pplica 0 uremo	9 ent of riods
type Digi UN Class press	e potention ital multi- IT V ssification ssure, temp <b>xt Books</b> A.K.	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. MEASUREMENT OF NON-ELECTRICAL QUANTIT of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors	TIES Id Hall effect transo Total (45	9 lucers. 5L + 07 hanpat	$\begin{bmatrix} 0 \\ Meas \\ \Gamma \end{bmatrix} = 4$ Rai ar	pplica 0 uremo 15 Pe	9 ent of riods
UN Class press Tex 1. 2.	e potention ital multi- IT V ssification ssure, temp <b>xt Books</b> A.K.	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. <b>MEASUREMENT OF NON-ELECTRICAL QUANTIT</b> of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors Sawhney, "A Course in Electrical & Electronics Measurement & I Doebelin, "Measurements Systems- Application and Design", Tat	TIES Id Hall effect transo Total (45	9 lucers. 5L + 07 hanpat	$\begin{bmatrix} 0 \\ Meas \\ \Gamma \end{bmatrix} = 4$ Rai ar	pplica 0 uremo 15 Pe	9 ent of riods , 2015
UN Class press Tex 1. 2.	e potention ital multi- ITT V ssification ssure, temp kt Books: A.K. E.O. ference H	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. <b>MEASUREMENT OF NON-ELECTRICAL QUANTIT</b> of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors Sawhney, "A Course in Electrical & Electronics Measurement & I Doebelin, "Measurements Systems- Application and Design", Tat	Total (45 nstrumentation", D a McGraw Hill put	9 lucers. blt + 07 hanpat	$\begin{bmatrix} 0 \\ Meas \\ \Gamma \end{bmatrix} = 4$ Rai ar	pplica 0 uremo 15 Pe	9 ent of riods , 2015
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type Dig: UN Clas pres Tex 1. 2. <b>Ref</b> 1. 2. 3.	tital multi- ital multi- ssification ssure, tem kt Books A.K. E.O. ference H D.V. H.S. Mart Reference	meter, Cathode Ray Oscilloscope and Digital storage Oscilloscope meters, Digital voltmeters. MEASUREMENT OF NON-ELECTRICAL QUANTIT of transducers –Position transducers, Piezo-electric transducers an perature and displacement– Introduction to Smart Sensors Sawhney, "A Course in Electrical & Electronics Measurement & I Doebelin, "Measurements Systems- Application and Design", Tat Books: S. Moorthy, "Transducers and Instrumentation", Prentice Hall of I Kalsi, "Electronic Instrumentation", Tata McGraw Hill, 2015. in Reissland, "Electrical Measurements", New Age International(F	Total (45 nstrumentation", D a McGraw Hill put	9 Jucers. 5L + 07 hanpat	$\begin{bmatrix} 0 \\ Meas \\ \Gamma \end{bmatrix} = 4$ Rai ar	pplica 0 uremo 15 Pe	9 ent of riods , 2015

Cours	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Recall the fundamentals of measurement system in electrical engineering.	L1: Remembering
CO2	:	Describe the working principle of different measuring instruments.	L2: Understanding
CO3	:	Choose appropriate instrument for measuring the electrical parameters.	L3: Applying
CO4	:	Employ the digital instruments in real time measurements.	L3: Applying
CO5	:	Select and use an appropriate transducer for measurement of non-electrical quantities.	L4: Analysing

23PTCY30		NEERING	SEM	IEST	'ER	III
PREREQU	JISITES	CATEGORY	ES	Cr	edit	3
Nil		Hours / Week	L 3	T	P	TH
Course Ob	instinger		3	0	0	3
Course Ob	e students conversant with the					
	iples of environmental resources.					
	rvation of ecosystem and biodiversity.					
	iples of environmental threats and pollution.					
	iples of solid waste management.					
	onmental issues and ethics.					
UNIT I	ENVIRONMENTAL RESOURCES		9	0	0	9
	rces – importance, deforestation – water resources – hydrological	l cycle – food resour	Ces _ e	-	-	-
-	fertilizers, pesticides – Land Resources- Land degradation-soil er tal effects of extracting and using mineral resources.	rosion- Mineral resou	urces –	types	– mii	ning -
UNIT II	ECOSYSTEM AND BIODIVERSITY		9	0	0	9
Webs -tropic values of bio	t – biotic and abiotic components – Ecosystem – components –Er c levels – energy flow in ecosystem, ecological pyramids – ecolog odiversity, hot spots of biodiversity, threat to biodiversity, endang – In-situ and Ex-situ conservation.	gical succession, type	es – Bio	odive	rsity, 1	types
				-		
Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu	<b>ENVIRONMENTAL POLLUTION</b> n – classification of air pollutants - gaseous, particulates – source l <sub>2</sub> S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on Dissolved oxygen (DQ) BOD and COD - experimental determ	cyclone separator, ele n demanding wastes,	ctrosta aerobi	itic pr ic and	recipit l anae	tator- robic
SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi	$n$ – classification of air pollutants - gaseous, particulates – source $I_2S$ , CO and particulates – control methods – catalytic convertor, c	cyclone separator, ele a demanding wastes, nination of BOD only	l of ga ctrosta aerobi	seous itic pi ic and	pollu recipit l anae	tants, tator– robic
Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi and industria <b>UNIT IV</b>	n – classification of air pollutants - gaseous, particulates – source l <sub>2</sub> S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on, Dissolved oxygen (DO), BOD and COD - experimental detern al wastewater – Noise pollution –decibel scale - sources, effects ar ENVIRONMENTAL THREATS AND SC MANAGEMENT	cyclone separator, ele n demanding wastes, nination of BOD only nd control measures.	l of ga actrosta aerobi , treati	seous ttic pr ic and ment o	pollu recipit l anae of don	tants tator- erobic nestic
Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi- and industria <b>UNIT IV</b> Eutrophicati smog – disas wastes, class incineration, <b>UNIT V</b>	<ul> <li>n – classification of air pollutants - gaseous, particulates – source l<sub>2</sub>S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on, Dissolved oxygen (DO), BOD and COD - experimental detern al wastewater – Noise pollution –decibel scale - sources, effects ar</li> <li>ENVIRONMENTAL THREATS AND SO MANAGEMENT</li> <li>on, bio amplification, acid rain, greenhouse effect and global warn ster management – origin, effects and management of earthquake sification, origin, effects – treatment methods – composting, sa , pyrolysis, 3R (reduce, reuse and recycling).</li> </ul>	cyclone separator, ele a demanding wastes, nination of BOD only nd control measures. DLID WASTE ming, ozone layer def and floods. Solid was unitary land filling –	l of ga actrosta aerobi , treati , treati 2 9 pletion ste man destru 9	seous ttic price and ment of 0 , phot nagen ictive	pollurecipit l anae of dom of dom of content meth 0	tants, tator- erobic nestic 9 mical solid ods -
Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi and industria <b>UNIT IV</b> Eutrophicati smog – disas wastes, class incineration, <b>UNIT V</b> From unsust energy conse ethics – conse	n – classification of air pollutants - gaseous, particulates – source l <sub>2</sub> S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on, Dissolved oxygen (DO), BOD and COD - experimental detern al wastewater – Noise pollution –decibel scale - sources, effects ar <b>ENVIRONMENTAL THREATS AND SC</b> <b>MANAGEMENT</b> on, bio amplification, acid rain, greenhouse effect and global warn ster management – origin, effects and management of earthquake sification, origin, effects – treatment methods – composting, sa , pyrolysis, 3R (reduce, reuse and recycling).	cyclone separator, elen n demanding wastes, nination of BOD onlynd control measures. DLID WASTE ming, ozone layer dej and floods. Solid was nitary land filling – S ieving – urban problesting – waste land red	l of ga actrosta aerobi , treati , treati 2 9 pletion ste mai destru 9 ems rel clamati	seous ttic price and ment of 0 , phot nagen active 0 lated t ion. E	pollurecipit anaeof dom of dom of dom co che nent – meth o ene nviro	tants, tator crobic nestic 9 mical solic ods - <b>9</b> rgy a
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Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi- and industria <b>UNIT IV</b> Eutrophicati smog – disas wastes, class- incineration, <b>UNIT V</b> From unsust energy cons- ethics – con- welfare prog <b>Text Book</b> 1. P.Meen 2 Dr. S.S.	n – classification of air pollutants - gaseous, particulates – source I <sub>2</sub> S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on, Dissolved oxygen (DO), BOD and COD - experimental detern al wastewater – Noise pollution –decibel scale - sources, effects ar <b>ENVIRONMENTAL THREATS AND SO MANAGEMENT</b> on, bio amplification, acid rain, greenhouse effect and global warn ster management – origin, effects and management of earthquake sification, origin, effects – treatment methods – composting, sa pyrolysis, 3R (reduce, reuse and recycling). <b>SOCIAL ISSUES AND ENVIRONMENTAL ETHICS</b> tainable to sustainable development, objectives, and ways of achi ervation – water conservation and management, rainwater harves sumerism – human population, exponential and logistic growth, p gramme – population control methods – HIV and AIDS. <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b> <b>SI</b>	cyclone separator, elen a demanding wastes, nination of BOD only nd control measures.  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Air pollution SO <sub>x</sub> , NO <sub>x</sub> , H Water pollu decompositi- and industria <b>UNIT IV</b> Eutrophicati smog – disas wastes, class- incineration, <b>UNIT V</b> From unsust energy conse- ethics – con- welfare prog <b>Text Book</b> 1. P.Meen 2. Dr. S.S. Ecolog <b>Reference</b>	n – classification of air pollutants - gaseous, particulates – source I <sub>2</sub> S, CO and particulates – control methods – catalytic convertor, c tion – heavy metal ions pollutants – organic pollutants, oxygen on, Dissolved oxygen (DO), BOD and COD - experimental detern al wastewater – Noise pollution –decibel scale - sources, effects ar <b>ENVIRONMENTAL THREATS AND SC</b> <b>MANAGEMENT</b> on, bio amplification, acid rain, greenhouse effect and global warn ster management – origin, effects and management of earthquake sification, origin, effects – treatment methods – composting, sa pyrolysis, 3R (reduce, reuse and recycling). <b>SOCIAL ISSUES AND ENVIRONMENTAL ETHICS</b> tainable to sustainable development, objectives, and ways of achi ervation – water conservation and management, rainwater harves sumerism – human population, exponential and logistic growth, p gramme – population control methods – HIV and AIDS. <b>S:</b> nakshi, "Elements of Environmental Science and Engineering", Pr S. Dara and D.D. Mishra, "A Textbook of Environmental Chem sy, Ethics and Society)", Revised Edition, S. Chand & Company L	cyclone separator, elen a demanding wastes, nination of BOD only nd control measures. <b>DLID WASTE</b> ming, ozone layer dej and floods. Solid was unitary land filling – <b>S</b> ieving – urban proble sting – waste land rea population explosion, <b>Total (45)</b> rentice — Hall of Ind histry and Pollution ( Ltd, 2014.	l of ga l of ga actrosta aerobi y, treati 2 9 pletion ste mai destru 9 ems rel clamati popula L + 01 lia, Nev Contro	seous ttic price and ment of <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b> <b>0</b>	pollurecipit l anacof dom of dom of dom to chement – meth to ene covicy solicy bith Er	soliciods - <b>9</b> mical soliciods - <b>9</b> <b>1</b> <b>9</b> <b>1</b> <b>9</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>

E-R	E-References:						
1.	www.onlinecourses.nptel.ac.in/						
2.	www.ePathshala.nic.in						

<b>Cour</b> Upon		Bloom's Taxonomy Mapped	
CO1	:	Play an important role in conservation of natural resources for future generation.	L6: Creating
CO2	:	Paraphrase the importance of ecosystem and biodiversity.	L2: Understanding
CO3	:	Analyze the impact of pollution and hazardous waste in a global and social context.	L4: Analyzing
CO4	:	Understand contemporary issues that result in environmental degradation that would attempt to provide solutions to overcome the problems.	L2: Understanding
CO5	:	Consider the issues of environment and human population in their professional undertakings.	L3: Applying

23PTEE401		POWER GENERATION, TRANSMISSION AND		SE	IV				
231	1 66401	<b>DISTRIBUTION SYSTEM</b>		SE.	MEST		1 4		
PRI	EREQUIS	ITES	CATEGORY	PC	Cr	edit	3		
Flec	tric circuit	analysis, Electromagnetic Theory	Hours / Week	L	Т	Р	TH		
			Hours / Week	2	1	0	3		
Cou	ırse Objeo	tives:							
1.	To impa	t knowledge on power generation plants and Substation							
2.	To study	the line parameters and analyze the performance of the transm	ission system						
3.	To learn	insulators, cables and grounding methodologies for power syst	tem						
UNI		POWER GENERATION SYSTEMS		6	3	0	9		
	Structure of electric power system-Terms, factors and significance of Load curve -Economics of								
		y- Power generating Station: layout and operation of Thermal	l power plant, Hyd	roelect	ric pov	ver pla	nt and		
Nucl	lear power	plants –Comparison of power plants.							
TINI				(		0	0		
		TRANSMISSION LINE PARAMETERS		<u>6</u>	3	0	9		
		Inductance and capacitance calculations of single phase and the Effect of earth on the capacitance of the transmission line–Skin	*			-			
		and communication lines.	i and proximity en	ects-m	auctiv	e mierro	erence		
Detw	leen power	and communication mes.							
UN		PERFORMANCE OF TRANSMISSION LINES		6	3	0	9		
		of Lines-Performance of Short line, medium line and long th	ransmission line:						
-		mission efficiency and voltage regulation, ABCD constants-		-					
-	na effect.		8F	C					
UN	IT IV 🛛 🤇	OVERHEAD LINE INSULATORS AND CABLES		6	3	0	9		
Insu	lators: Typ	es, Potential distribution over a string of suspension inst	ulators- improven	nent o	f strin	g effic	iency.		
	-	bles: Constructional features of LT and HT cables, capacitance	-		ore cab	les, die	lectric		
stres	s in a singl	e core cable- grading of cables, thermal resistance of dielectric	of a single core ca	ble.					
			~~~~~		1				
UN		SUBSTATION, GROUNDING SYSTEM AND DI	STRIBUTION	6	3	0	9		
		SYSTEM		-					
	•	out and operation-bus-bar arrangements in sub stations- Grou	U U	• •		U	U		
	-	rounding- Transformer Earthling-Distribution system: Classif	ication, Layout of	AC a	nd DC	distrib	ution,		
Com	nection Sch	emes of Distribution system.							
			Total (3	$\mathbf{D}_{L} + 1$	(5T) =	45 Pe	riods		
			10000 (0)		(01)-		11045		
Tex	t Books:								
1.	C.L. Wad	nwa, "Electrical Power Systems", New age International (P) Lt	td., 2018.						
		, "Electric Power Generation, Transmission and Distribution"		PHI Pv	zt. Ltd.	. New	Delhi.		
2.	2012.		,		. 2	,			
Ref	erence Bo	oks:							
			t I td New Delhi	2012					
1.									
	<ol> <li>Ray, "Electrical Power systems: Concepts, Theory and Practice", PHI Pvt.Ltd., New Delhi,2012.</li> <li>V.K. Mehta and Rohit Mehta, "Principles of Power System", S.Chand &amp; Company Ltd., New Delhi, 2012.</li> </ol>								

E-Reference:
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1. https://archive.nptel.ac.in/courses/108/102/108102047/

Cours	se (	Bloom's Taxonomy			
Upon	Upon completion of this course, the students will be able to:		Mapped		
CO1	:	Explain the operation of generating stations and substations.	L2: Understanding		
CO2	:	Model the transmission lines using system parameters.	L3: Applying		
CO3	:	Analyze the performance of different types of transmission lines.	L4: Analysing		
CO4	:	Select an appropriate insulator and cable for transmission and distribution system.	L3: Applying		
CO5	:	Describe the substation components and grounding techniques.	L1: Remembering		

23PT	23PTEE402 MICROPROCESSOR AND MICROCONTROLLER			SEN	IV		
PRE	REQ	UISITES	CATEGORY	PC	Cr	edit	3
C Dro	aromn	sing	Harry / Weak	L	Т	P	TH
CFIC	ogramn	inig	Hours / Week	3	0	0	3
Cou	rse Ol	ojectives:					
1.		udy the architecture of $\mu$ P8085 and $\mu$ C 8051					
2.		udy the Interrupt structure of 8085 and 8051.					
3.	To de	o simple applications development with programming 8085 and 805	1.				
							0
UNI		8085 8 BIT MICROPROCESSOR		9	0	0	9
		ls of microprocessors – Architecture of 8085 – Groups of Instruc		-			-
		rganization and addressing of Memory and I/O systems –Interrupt system design and programming.	structure – Stack al	na sub	-routi	nes - 3	Simple
8085	Daseu	system design and programming.					
UNI	тп	8051 8 BIT MICROCONTROLLER		9	0	0	9
	Fundamentals of microcontrollers – Architecture of 8051 – Groups of Instructions - Addressin					_	
		stems – I/O Ports – Timers/Counters – Serial Port - Interrupt struct	U			-	
		and Compliers.	are simple prog	. unini	ing 00	neepta	using
		1					
UNI	T III	INTERFACING WITH 8051 MICROCONTROLLER		9	0	0	9
		quirements of interfacing – Interfacing – LED, 7 segment and LCD D	isplays – Tactile sy		-	rix ke	
		DC – DAC – Interfacing of Current, Voltage, RTD and Hall Sensors			, 	-	, ,
UNI	T IV	EXTERNAL COMMUNICATION INTERFACE		9	0	0	9
Syncl	hronou	s and Asynchronous Communication. RS232, RS 485, SPI, I2C. In	troduction and inte	rfacing	g to p	rotoco	ls like
Blue-	tooth a	nd Zig-bee.					
UNI	ΤV	APPLICATIONS OF MICROCONTROLLERS		9	0	0	9
Simp	le prog	ramming exercises- key board and display interface -Control of service	vo motor stepper m	notor c	ontrol	i-	
Appli	ication	to automation systems.					
			Total (45	SL + 0	<b>T</b> ) =	45 Pe	eriods
Text	Book	s:					
	R.S.	Gaonkar, "Microprocessor Architecture Programming and Applica	tion with 8085", V	Viley l	Easter	n Ltd	, New
1.		ni, 2013.		•			
2.	K. J	Ayala, "8051 Microcontroller", Delmar Cengage Learning, 2004.					
		ammad Ali Mazidi, Janice GilliMazidi, and R.D.Kinely, "The 8051	Micro Controller a	nd Em	bedde	ed Sys	tems",
3.		Pearson Education, 5th Indian reprint, 2003.				-	
Refe	rence	Books:					
1.	R. K	amal, "Embedded System", McGraw Hill Education,2009.					
2.	2. D. V. Hall, "Microprocessors & Interfacing", McGraw Hill Higher Education, 1991.						

E-Ref	E-References:					
1.	www.onlinecourses.nptel.ac.in/noc18_ee41					
2.	www.class-central.com					
3.	www.mooc-list.com					

Cour	se (	Bloom's Taxonomy	
Upon	Upon completion of this course, the students will be able to:		Mapped
CO1	:	Understand the basics of microprocessor and microcontroller	L2: Understanding
CO2	:	Understand the architecture of microprocessor and microcontroller	L1: Remembering
CO3	:	Apply the digital concepts to measure and control simple electrical systems	L3: Applying
CO4	:	Design and interface communications between digital systems	L2: Understanding
CO5	:	Design a microcontroller based electrical control system.	L5: Evaluating

23PTEE403 BIOMEDICAL INSTRUMENTATION					SEMESTER		
PRE	REQ	UISITES	CATEGORY	PC Credit		edit	3
Basic	Ele	ctrical and Electronics Engineering, Measurements and		L	Т	Р	TH
Instru	imenta	• •	Hours / Week	3	0	0	3
Cou	rse Ol	ojectives:					
1.		ovide an adequate knowledge of the human physiology systems.					
2.	To in	troduce different transducers for Biomedical applications.					
3.	To in	troduce the student to the various sensing and measurement devices	of bio-medical elec	trical s	ystem	ıs.	
4.	To pi	ovide awareness of electrical safety of medical equipment.					
UNI	тт	HUMAN PHYSIOLOGICAL SYSTEMS AND BIO	POTENTIAL	9	0	0	9
0111	1 1	ELECTRODES AND TRANSDUCERS			U	U	,
		eir structure – Nature of Cancer cells – Transport of ions through the		-		-	
		c potential - nerve tissues and organs - difference systems of huma				•	
	-	-Cardiovascular system- Respiratory system- nervous system. Des	ign of medical inst	ruments	s com	pone	nts of
biom	edical	nstrument systems – electrodes - transducers.					
TINIT	тп	DIO CICNAL A COLUCITION DIO DOTENTIAL DECO	DDEDG	0	0	Δ	0
UNI		BIO SIGNAL ACQUISITION BIO POTENTIAL RECO		9	0	0	9
-	-	al signal amplifiers – isolation amplifiers – medical pre amplifie current amplifiers – chopper amplifiers – bio signal analysis – s	• •	-			
-		on in operational amplifiers – pattern recognition. Characteristics			-		
-		ectroencephalography (EEG) – Electromyography (EMG) – Electro				-	
		corders for offline analysis.	Tetinography (EKO	) & Ele	cuoo	culog	гарпу
(LOC	<i>y</i> icc						
UNI	T III	SPECIALIZED MEDICAL EQUIPMENT AND BIO-TH	ELEMETRY	9	0	0	9
Blood	t cell c	counter – Electron microscope – radiation detectors – photo meters	s and colorimeters -	– digita	1 ther	mom	eter –
audio	meter	s - X-ray tube $- X$ -ray machine $- Radiography and fluoroscopy - imaginary mathematical fluorescopy - imaginary mathem$	ige intensifiers – ang	giograpl	hy – a	pplic	ations
of X-	ray exa	amination. Biotelemetry					
UNI	т іv	PHYSIOLOGICAL ASSIST DEVICES AND OPERATI	ON THEATRE	9	0	0	9
		EQUIPMENT				Ŭ	
		- Pacemaker batteries - artificial heart walls - Defibrillators - n					U
		tidney machine. Surgical diathermy – short wave diathermy – micr	•				•
-		effect of heat – range and area of irritation of different diathermy tech					
		v meters - Cardiac output measurements - Pulmonary function anal	yzers – Blood gas a	analyzei	rs – o	xyme	eters –
eleme	ents of	intensive care monitoring.					
				1	1	1	
UNI	ТΥ	SAFETY INSTRUMENTATION AND ADVANCES IN	BIOMEDICAL	9	0	0	9
		INSTRUMENTATION					
		afety instrumentation – physiological effects due to 50 Hz current					
		cidents in hospitals – Devices to protect against electrical hazards – h	-	-			
		edicine – endoscope – Cryogenic surgery – Nuclear imaging techniqu	-			-	
		e imaging system - Magnetic resonance imaging - Positron em	ission tomography	– digit	al su	bs tr	action
angio	graphy	<i>.</i>					
				r 0/7			• •
			Total (45)	L + 0T	) = 4	5 Pe	riods

Text B	ooks:				
1.	U. Satyanarayana "Biochemistry", 5th edition – Sri Padmavathi Publications Ltd.,2017.				
2.	N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: Aglobal approach", Pearson				
۷.	Education Ltd, 2014.				
3.	Dr.M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2012.				
4.	Leslie Cromwell, Fred J.Weibell, and Erich A.Pfeiffer, "Bio-Medical Instrumentation and Measurements", II				
4.	edition, Pearson Education, 2011 / PHI.				
Reference Books:					
1.	R.S.Khandpur, "Hand Book of Bio-Medical Instrumentation", Tata McGraw Hill Publishing Co Ltd., 2012.				
2.	L.A. Geddes and L.E.Baker, "Principles of Applied Bio-Medical Instrumentation", John Wiley &Sons, 2011.				
3.	C.Rajarao, "Medical Instrumentation", John Wiley & Sons, 2013.				
4.	C.Rajarao and S.K. Guha, "Principles of Medical Electronics and Bio-medical Instrumentation", Universities press				
4.	4. (India) Ltd, Orient Longman ltd, 2012.				
E-Ref	erence:				
1.	www.onlinecourses.nptel.ac.in				

Cours	se (	Bloom's Taxonomy		
Upon	Upon completion of this course, the students will be able to:		Mapped	
CO1	:	Remember the purpose & methods of measurement.	L1: Remembering	
CO2	:	Understand different display and recording devices for various applications.	L2: Understanding	
CO3	:	Evaluate electrical & non electrical physiological measurements and bio amplifier.	L5: Evaluating	
CO4	:	Apply physiological assist devices and operational theatre equipment.	L3: Applying	
CO5	:	Design biomedical equipment as it is a challenging interdisciplinary process	L6: Creating	

23P	THS40	1 UNIVERSAL HUMAN VALUES	S	SE	MES	TER	IV			
PRE	REQU	ISITE	CATEGORY	HS	Cı	redit	3			
				L	Т	Р	ТН			
Univ	ersal n	uman values introduction	Hours / Week	2	1	0	3			
COU	COURSE OBJECTIVES									
1.		velopment of a holistic perspective based on self-exploration	about themselves	(human	being)	), family,	society			
	and n	ature/existence.								
2.		derstanding (or developing clarity) of the harmony in the huma	an being, family, so	ociety a	nd nati	ure/existe	ence.			
3.	To str	engthening of self-reflection.								
4.	To de	velopment of commitment and courage to act.								
TINIT	<u>тт</u>				2	•	0			
UNI		BASIC CONCEPTS OF HUMAN VALUES	1 1 1 1 1 1	6	3	0	9			
		duction - Need, Basic Guidelines, Content and Process for Va		-						
	-	bitulation from Universal Human Values-I. Self-Exploration			-					
	-	and Experiential Validation- as the process for self-exploration	-	-						
		an Aspirations. Right understanding, Relationship and Physic	•	-						
	-	of every human being with their correct priority. Understandi		-	-	-				
		the current scenario Method to fulfil the above human aspin	rations- understand	ling an	d livin	g in harr	nony at			
vario	us level	S.								
UNI	тп	UNDERSTANDING HARMONY IN THE HUMAN	N BEING	6	3	0	9			
-		g Harmony in the Human Being - Harmony in Myself! Und			-		-			
		nd the material 'Body' Understanding the needs of Self ('I	-	-						
		ing the Body as an instrument of 'I' (I being the doer, seer an			-		-			
		I' and harmony in 'I' Understanding the harmony of I with th		-						
		ls, meaning of Prosperity in detail Programs to ensure Sanyar	• •	na me	iui, <b>c</b> oi	reet uppi	uisui oi			
1 11 9 5.	ieur nee	ss, meaning of Prosperity in detail Programs to ensure Sanjar								
TINI		UNDERSTANDING HARMONY IN THE FA	AMILY AND	(	2	•	•			
UNI	TIII	SOCIETY		6	3	0	9			
Unde	erstandi	g Harmony in the Family and Society- Harmony in Humar	n- Human Relation	nship U	ndersta	anding va	alues in			
		n relationship; meaning of Justice (nine universal values in		-		-				
		l happiness; Trust and Respect as the foundational values of r	-							
		etween intention and competence. Understanding the meani	-		-	-				
differ	rentiatio	n; the other salient values in relationship. Understanding the h	armony in the soci	ety (soc	eiety be	ing an ex	tension			
of fa	mily): I	Resolution, Prosperity, fearlessness (trust) and co-existence	as comprehensive	Huma	n Goal	ls. Visua	lizing a			
	-	monious order in society- Undivided Society, Universal Orde	-				•			
				-						
UNI	TIV	UNDERSTANDING HARMONY IN THE NA EXISTENCE	ATURE AND	6	3	0	9			
Unde	Understanding Harmony in the Nature and Existence - Whole existence as Coexistence. Understanding the harmony in the									
		connectedness and mutual fulfilment among the four orders of			-		•			
	Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of									
	harmony at all levels of existence.									
UNI	ΤV	HOLISTIC UNDERSTANDING OF HARMONY		6	3	0	9			
Impli	cations	of the above Holistic Understanding of Harmony on Professio	onal Ethics. Natural	l accept	ance of	f human v	values.			
-	Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic									

Universal Order. Competence in professional ethics, Strategy for transition from the present state to Universal Human Order.

	<b>Total (30L + 15T) = 45 Periods</b>
Text	Books:
1.	R.R.Gaur, R.Sangal, and G.P.Bagaria, "Human Values and Professional Ethics", Excel Books, New Delhi, 2010.
Refe	rence Books:
1.	Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3.	The Story of Stuff (Book)
4.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5.	Small is Beautiful - E. F Schumacher.
6.	Slow is Beautiful - Cecile Andrews
7.	Economy of Permanence - J C Kumarappa
8.	Bharat Mein Angreji Raj - PanditSunderlal
9.	Rediscovering India - by Dharampal
10.	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11.	India Wins Freedom - Maulana Abdul Kalam Azad
12.	Vivekananda - Romain Rolland (English)
13.	Gandhi - Romain Rolland (English)

COU Upon		Bloom's Taxonomy Mapped	
CO1	:	Become more aware of themselves, and their surroundings (family, society, nature) and become more responsible in life	L5: Evaluating
CO2	:	Handle problems with sustainable solutions, while keeping human relationships and human nature in mind	L3: Applying
CO3	:	Become sensitive to their commitment towards what they have understood (human values, human relationship and human society)	L5: Evaluating
CO4	:	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	L3: Applying

<b>23PTEE404</b>		MICROPROCESSOR AND MICROCONTROL LABORATORY	SEM	IV			
PRE	REQUIS		ATEGORY	PC	PC Credit		
Anal	og and Dig	Digital Integrated Circuits, Microprocessor and Microcontroller Hours / Weel		L	Т	Р	TH
Anan		nai integrated circuits, wheroprocessor and wherocontroller	ours / week	0	0	2	2
Cou	rse Objec						
1.	Able to v	write own programs for different applications and interface the prog	rams for interco	onnected	l digit	al sys	stems
LIST	Γ OF EXI	PERIMENTS:					
1		rithmetic operations: addition / subtraction / multiplication / divisio	n.				
2	-	ming with control instructions:					
	U	a. Ascending / Descending order, Maximum / Minimur	n of numbers				
		b. Programs using Rotate instructions					
		c. Hex / ASCII / BCD code conversions.					
3	Interface	Experiments: with 8085					
	interface	a. A/D Interfacing. & D/A Interfacing.					
4	Traffic li	ght controller.					
5		/ Serial communication					
6		ming Practices with Simulators/Emulators/open source					
7	-	d interfacing					
8	-	erfacing 4bit/8bit mode					
9		ration of basic instructions with 8051 Micro controller execution, in	ncluding:				
		a. Conditional jumps, looping	U				
		b. Calling subroutines.					
10	Program	ming I/O Port 8051					
	_	a. Interface with external A/D & D/A					
11		b. Interface with stepper motor					
11	Interrupt	programming with external sensors/ devices					
12	Programm	ming for communication using Zigbee protocol.					
			Total (07	Γ + <b>30</b> Ι	<b>P</b> ) = 3	0 Pe	riod
Refe	erence Bo	oks:					
1.	-	onkar, "Microprocessor Architecture: Programming and Applicatio	ns with the 808	5". Penr	am In	terna	tiona
1.	Publishin			, , , , , , , , , , , , , , , , , , , ,			
2.		ila, "8051 Microcontroller", Delmar Cengage Learning, 2004.					
3.	M.A.Maz	zidi, J.G. Mazidi and R. D. McKinlay, "The 8051Microcontry and C", Pearson Education, 2007.	oller and Em	bedded	Syste	ms: 1	Using
4.		l, "Embedded System", McGraw Hill Education, 2009.					
5.	D V Ha	ll, "Microprocessors & Interfacing", McGraw Hill Higher Education	on. 1991.				

Cour	se (	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Write coding to implement different types of algorithms	L1: Remembering
CO2	:	Design and implement simple controllers	L3: Applying
CO3	:	Use simulators and emulators for debugging and verifying codes	L3: Applying
CO4	:	Write efficient codes using interrupts for time critical applications	L4: Analyzing
CO5	:	Interface any application module to microprocessor/microcontroller.	L5: Evaluating

	ГЕЕ501	POWER SYSTEM ANALYSIS AND STABILIT	ſY	SEM	EST	ER	V
PRE	REQUI	SITES CA	TEGORY	PC	Cre	edit	3
Circu	it Theory	, Electrical Machines,	urs / Week	L	Т	Р	TH
Powe	er Generat	ion, Transmission and Distribution System	urs / week	2	1	0	3
Cour	rse Obje	ctives:					
1.	To mod	el the power system under steady state operating condition					
2.	To appl	y efficient numerical methods to solve the power flow problem					
3.	To mod	el and analyse the power systems under abnormal (or) fault conditions					
4.	To mod	el and analyse the transient behaviour of power system when it is subje	ected to a faul	t.			
UNI	TI P	OWER SYSTEM OVERVIEW AND MODELLING		6	3	0	9
Basic		ents of modern power system - Per-phase analysis: Generator model	- Synchrono	us moto	-	del- T	-
	-	ner model - Three-winding transformer model - Line model, Load mod	-				
-		it quantities - Single line diagram -Impedance and reactance diagrams.	····· <u>1</u>			0	0
	1						
UNI	T II P	OWER FLOW ANALYSIS		6	3	0	9
		ion – Bus admittance matrix Formulation: Direct inspection method a	and Singular	-		-	-
		of power flow model - solution of load flow equations: Gauss Seidel me	-				
	-	hod – Flowcharts – Comparison of the three power flow solution method		ii itapin	,011 111	emou	1 45
accor	apieu mee		045.				
UNI	T III F	AULT ANALYSIS - BALANCED FAULT		6	3	0	9
Impo	rtance of	short circuit studies-Assumptions in short circuit analysis – Balanced th	ree phase fau	lt – Shor	t circ	uit cap	oacity
- Alg	orithm fo	r formation of the bus impedance matrix- Systematic fault analysis us	ing bus impe	dance m	atrix	- Post	fault
bus v	oltages –	Fault level - Current limiting reactors - Selection of circuit breakers.					
UNI						•	
	T IV F	AULT ANALYSIS - UNBALANCED FAULT		6	3	0	9
		AULT ANALYSIS - UNBALANCED FAULT of symmetrical components – Sequence impedances – Construction of	f sequence ne				-
Funda	amentals	of symmetrical components - Sequence impedances - Construction of	-	tworks -	- Uns	ymme	trical
Funda faults	amentals s on powe		fault- Unbala	tworks - nced fau	- Uns	ymme alysis	trical
Funda faults	amentals s on powe	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground	fault- Unbala	tworks - nced fau	- Uns	ymme alysis	trical
Funda faults Theve	amentals s on powe enin's the	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground	fault- Unbala	tworks - nced fau hasor do	- Uns ilt ana omain	ymme alysis	trical
Funda faults Theve <b>UNI</b>	amentals s on powe enin's the <b>T V S</b>	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground forem and Z-bus computation of post fault currents in symmetrical com TABILITY STUDIES	fault- Unbala ponent and p	tworks - nced fau hasor do <u>6</u>	- Uns ilt ana omain <b>3</b>	ymme alysis s. 0	trical using 9
Funda faults Theve <b>UNI</b> Impor	amentals s on powe enin's the <b>T V S</b> rtance of	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground forem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability 1	fault- Unbala ponent and p imits – Power	tworks - nced fau hasor do <u>6</u> r angle e	- Uns ult ana omain <b>3</b> equati	ymme alysis s. <b>0</b> on- Ir	trical using 9 ertia
Funda faults Theve UNI Impor	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw	fault- Unbala ponent and p imits – Power	tworks - nced fau hasor do 6 r angle e by step-	- Uns ilt ana omain <b>3</b> equati by-ste	ymme alysis s. 0 on- Ir	trica using 9 ertia hod-
Funda faults Theve <b>UNI</b> Import consta II – N	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin Modified	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti	fault- Unbala ponent and p imits – Power	tworks - nced fau hasor do 6 r angle e by step-	- Uns ilt ana omain <b>3</b> equati by-ste	ymme alysis s. 0 on- Ir	trical using 9 ertia hod-
Funda faults Theve <b>UNI</b> Import consta II – N	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin Modified	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw	fault- Unbala ponent and p imits – Power	tworks - nced fau hasor do 6 r angle e by step-	- Uns ilt ana omain <b>3</b> equati by-ste	ymme alysis s. 0 on- Ir	trical using 9 ertia hod-
Funda faults Theve <b>UNI</b> Impor consta II – N	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin Modified	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti	fault- Unbala ponent and p imits – Powe ving equation ical clearing	tworks - nced fau hasor do <b>6</b> r angle e by step- angle an	- Unsynthesis -	ymme alysis s. on- Ir p met p met	9 ertia hod- ctors
Funda faults Theve <b>UNI</b> Impor consta II – N	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin Modified	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti	fault- Unbala ponent and p imits – Power	tworks - nced fau hasor do <b>6</b> r angle e by step- angle an	- Unsynthesis -	ymme alysis s. on- Ir p met p met	9 ertia hod- ctors
Funda faults Theve UNI Impor consta II – N affect	amentals s on powe enin's the <b>T V S</b> rtance of ant- Swin Modified	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti	fault- Unbala ponent and p imits – Powe ving equation ical clearing	tworks - nced fau hasor do <b>6</b> r angle e by step- angle an	- Unsynthesis -	ymme alysis s. on- Ir p met p met	9 ertia hod- ctors
Funda faults Theve UNI Import consta II – N affect	amentals s on powe enin's the T V S rtance of ant- Swin Modified ting transi	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti	fault- Unbala ponent and p imits – Powe ving equation ical clearing a <b>Total (301</b>	tworks - nced fau hasor do 6 r angle e by step- angle an 2 + 15T	- Unsynthesis -	ymme alysis s. on- Ir p met p met	9 ertia hod- ctors
Funda faults Theve UNI Import consta II – N affect 1. 2	amentals s on powe enin's the T V S rtance of ant- Swin Modified ting transi Books: Hadi Saa D.P.Koth	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability 1 g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti ient stability – Techniques for transient stability improvement.	fault- Unbala ponent and p imits – Power ving equation ical clearing a <b>Total (301</b> lhi, 3 <sup>rd</sup> edition	tworks - nced fau hasor do <b>6</b> r angle of by step- angle an 2 + 151 h, 2011.	-  Uns alt analogous analogous <b>3</b> conduction c	ymme alysis s. on- Ir p met e -Fa	9 ertia hod- ctors
Funda faults Thevo UNI Impor consta II – N affect <b>Text</b> 1. 2.	amentals s on powe enin's the T V S rtance of ant- Swin Modified ting transi Books: Hadi Saa D.P.Koth Delhi, Fo	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti tent stability – Techniques for transient stability improvement. dat, "Power System Analysis", Tata McGraw Hill Publishers, New De- pari and I.J.Nagrath, "Modern Power System Analysis", Tata McGraw Purth Edition, 2019.	fault- Unbala ponent and p imits – Power ving equation ical clearing a <b>Total (301</b> lhi, 3 <sup>rd</sup> edition	tworks - nced fau hasor do <b>6</b> r angle of by step- angle an 2 + 151 h, 2011.	-  Uns alt analogous analogous <b>3</b> conduction c	ymme alysis s. on- Ir p met e -Fa	9 ertia hod- ctors
Funda faults Theve UNI Impor consta II – N affect 1. 2. <b>Refe</b>	amentals s on powe enin's the T V S rtance of ant- Swin Modified ting transi Books: Hadi Saa D.P.Koth Delhi, Fo	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability 1 g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti ient stability – Techniques for transient stability improvement. dat, "Power System Analysis", Tata McGraw Hill Publishers, New Defari and I.J.Nagrath, "Modern Power System Analysis", Tata McGraw burth Edition, 2019.	fault- Unbala ponent and p imits – Power ing equation ical clearing a <b>Total (301</b> Ihi, 3 <sup>rd</sup> edition 7 Hill Educati	tworks - nced fau hasor do 6 r angle e by step- angle an 2 + 15T h, 2011. on Prive	$- \text{ Uns}_{\text{all ana}}$ $3$ $2 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equat}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equat}_{\text{by-ste}_{\text{ad}}}$	ymme alysis s. on- Ir p met e -Fa	9 ertia hod- ctors
Funda faults Theve UNI Import consta II – N affect 1. 2. <b>Refe</b>	amentals s on powe enin's the T V S rtance of ant- Swin Modified ting transi Books: Hadi Saa D.P.Koth Delhi, Fo rence B John J. G	of symmetrical components – Sequence impedances – Construction of r system: Single line-ground fault, line-line fault – Double line-ground corem and Z-bus computation of post fault currents in symmetrical com <b>TABILITY STUDIES</b> stability studies – Classification of power system stability – Stability I g equation of single-machine connected to infinite bus – Solution of sw Euler's method – Runge-Kutta method – Equal area criterion – Criti tent stability – Techniques for transient stability improvement. dat, "Power System Analysis", Tata McGraw Hill Publishers, New De- pari and I.J.Nagrath, "Modern Power System Analysis", Tata McGraw Purth Edition, 2019.	fault- Unbala ponent and p imits – Power ing equation ical clearing a <b>Total (301</b> lhi, 3 <sup>rd</sup> edition / Hill Educati Hill Inc., New	tworks - nced fau hasor do 6 r angle e by step- angle an 2 + 15T h, 2011. on Prive	$- \text{ Uns}_{\text{all ana}}$ $3$ $2 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equati}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equat}_{\text{by-ste}_{\text{ad}}}$ $3 \text{ equat}_{\text{by-ste}_{\text{ad}}}$	ymme alysis s. on- Ir p met e -Fa	9 ertia hod- ctors

3.	C. L. Wadhwa, "Electrical Power Systems", New Age International Publishers, New Delhi, 2021.				
E-R	E-References:				
1.	1. https://onlinecourses.nptel.ac.in/, for power system analysis course, IIT Kharagpur				
2.	NPTEL courses on Power System Generation, Transmission and Distribution, IIT Delhi.				

Cour	se (	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Develop the single line diagram for the power system.	L3: Applying
CO2	:	Perform and analyse load flow computations using bus admittance matrix	L4: Analysing
CO3	:	Perform and analyse balanced fault using bus impedance matrix	L4: Analysing
CO4	:	Develop computational models for unsymmetrical fault analysis in power systems	L6: Creating
CO5	:	Demonstrate the transient stability studies.	L3: Applying

PREREQUI	POWER SYSTEM PROTECTION AND SWIT	CCH GEAR	SEM	EST	ER	V
INEREQUI	SITES	CATEGORY	PC	Cre	edit	3
Power Generat	ion, Transmission and Distribution systems, Measurements and	Hours / Week	L	Т	Р	TH
Instrumentation	1.	Hours / week	3	0	0	3
Course Obje	ctives:					
1. To acqui	re knowledge about the power system protection and switchgear	components.				
2. To under	rstand the concepts of various protection schemes for power syst	em equipment.				
3. To study	the functioning of static relays and numerical protection scheme	es.				
	DOTECTION AND DELAYS		•		0	0
	PROTECTION AND RELAYS ctive system – Protection system components – Zones of pro-		9	0	0	9
	nd principle of operation: Electromagnetic relays – directional :: Impedance, reactance and mho type – Differential relays – Tra y relays.					•
				T		
	CIRCUIT BREAKERS		9	0	0	9
	onstruction, working, characteristics, and applications - Physics very voltage and restriking voltage – expression for RRRV – cu	01				•
Selection of ch	t breakers - Problems of circuit interruption: - Rating of circu cuit breakers - HVDC circuit breakers.		0			
	cuit breakers - HVDC circuit breakers.					
UNIT III	cuit breakers - HVDC circuit breakers.	DN	9	0	0	9
UNIT III Alternator pro	Cuit breakers - HVDC circuit breakers.	DN e differential rela	9 ys, bala	<b>0</b> unced	<b>0</b> earth	<b>9</b> -fau
UNIT III Alternator pro protection, Stat Protection agai	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation,	<b>DN</b> e differential relation of stator winding	<b>9</b> ys, bala	0 inced ervolta	<b>0</b> earth age re	<b>9</b> -fau lays
UNIT III Alternator pro protection, Stat Protection agai on % winding t	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage for inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected.	<b>DN</b> e differential relay on of stator winding rotor fault protecti	<b>9</b> ys, bala s by ove on - nu	0 unced ervolta merica	0 earth age re 1 prol	9 -fau lays blem
UNIT III Alternator pro protection, Stat Protection agai on % winding to Transformer pr	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation,	<b>DN</b> e differential relay on of stator winding rotor fault protecti	<b>9</b> ys, bala s by ove on - nu	0 unced ervolta merica	<b>0</b> earth age re 1 prol	9 -faul lays blem
UNIT III Alternator pro protection, Stat Protection agai on % winding to Transformer pr restricted earth	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage for inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay.	<b>DN</b> e differential relation on of stator winding rotor fault protection numerical problem	9 ys, bala s by ove on - nur on desi	<b>0</b> unced ervolta merica gn of (	<b>0</b> earth age re 1 prol	<b>9</b> -fau lays blem ratio
UNIT III Alternator pro protection, Stat Protection agai on % winding to Transformer pr restricted earth UNIT IV	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay.	<b>DN</b> e differential relation on of stator winding rotor fault protection numerical problem	<b>9</b> ys, bala s by ove on - nu	0 unced ervolta merica	<b>0</b> earth age re 1 prol CTs r	<b>9</b> -fau lays blem ratio
UNIT III Alternator pro protection, Stat Protection agai on % winding t Transformer pr restricted earth UNIT IV AC Motor prot	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage for inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay.	<b>DN</b> e differential relation of stator winding rotor fault protection numerical problem <b>OTECTION</b>	9 ys, bala s by ove on - nur on desi 9	0 inced ervolta merica gn of 0	0 earth age re 1 prol CTs r	9 -fau lays blem ratio
UNIT III Alternator pro protection, Stat Protection agai on % winding	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. Totection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. MOTOR, BUS BAR AND TRANSMISSION LINE PR ection against short circuit, overload, and single phasing.	<b>DN</b> e differential relation of stator winding rotor fault protection numerical problem <b>OTECTION</b>	9 ys, bala s by ove on - nur on desi 9	0 inced ervolta merica gn of 0	0 earth age re 1 prol CTs r	9 -fau lays blem ratio
UNIT III Alternator pro protection, Stat Protection agai on % winding of Transformer pr restricted earth UNIT IV AC Motor prot Bus bar protec	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage for inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. <b>MOTOR, BUS BAR AND TRANSMISSION LINE PR</b> ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line	<b>DN</b> e differential relation of stator winding rotor fault protection numerical problem <b>OTECTION</b>	9 ys, bala s by ove on - nur on desi 9	0 inced ervolta merica gn of 0	0 earth age re 1 prol CTs r	9 -fau lays blem ratio
UNIT III Alternator pro protection, Stat Protection agai on % winding u Transformer pr restricted earth UNIT IV AC Motor prot Bus bar protec distance or imp	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage for inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. <b>MOTOR, BUS BAR AND TRANSMISSION LINE PR</b> ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line	DN e differential relay on of stator winding rotor fault protecti numerical problem OTECTION protection: Over (	9 ys, bala s by ove on - nur on desi 9	0 inced ervolta merica gn of 0	0 earth age re 1 prol CTs r	9 -fau lays blem ratio 9
UNIT III Alternator pro protection, Stat Protection agai on % winding	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. Totection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. MOTOR, BUS BAR AND TRANSMISSION LINE PR ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line pedance relay, Translay Relay.	DN e differential relation on of stator winding rotor fault protection numerical problem OTECTION protection: Over (	9 ys, bala s by ove on - nur on desi 9 Current, 9	0 unced ervolta merica gn of 0 0 Carrie	0 earth age re 1 prob CTs r 0 er Cu	9 -fau lays blem ratio 9 rren
UNIT III Alternator pro protection, Stat Protection agai on % winding to Transformer pr restricted earth UNIT IV AC Motor prot Bus bar protec distance or imp UNIT V Static relays –	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. <b>MOTOR, BUS BAR AND TRANSMISSION LINE PR</b> ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line bedance relay, Translay Relay.	DN e differential rela- on of stator winding rotor fault protecti numerical problem OTECTION protection: Over 0 N	9 ys, bala s by ove on - nur on desi 9 Current, 9 ttors – I	0 unced ervolta merica gn of 0 0 Carrie	0 earth age re l prol CTs r 0 er Cu er Cu	9 -fau lays blem atio 9 rren 9 am c
UNIT III Alternator pro protection, Stat Protection agai on % winding u Transformer pr restricted earth UNIT IV AC Motor prot Bus bar protec distance or imp UNIT V Static relays –	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. MOTOR, BUS BAR AND TRANSMISSION LINE PR ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line bedance relay, Translay Relay. STATIC RELAYS AND NUMERICAL PROTECTION Phase, Amplitude Comparators – Synthesis of various relays us	DN e differential relation on of stator winding rotor fault protection numerical problem OTECTION protection: Over ( N sing Static compara distance protection	9 ys, bala s by ove on - nur on desi 9 Current, 9 ttors – I of trans	0 unced ervolta merica gn of 0 0 Carrie	0         earth         age re         l prol         CTs r         0         er Cu         0         diagra         on lin	9 -fau lays blem ratio 9 rren 9 am ( e.
UNIT III Alternator pro protection, Stat Protection agai on % winding to Transformer pr restricted earth UNIT IV AC Motor prot Bus bar protec distance or imp UNIT V Static relays –	ALTERNATOR AND TRANSFORMER PROTECTION tection: Stator protection: Differential protection- Percentage or inter turn protection - Field ground fault protection - Protection nst stator open circuits, loss of synchronism, loss of excitation, unprotected. rotection: differential protection – biased differential protection- fault relay -Buchholz relay protection- harmonic restraint relay. MOTOR, BUS BAR AND TRANSMISSION LINE PR ection against short circuit, overload, and single phasing. tion: Differential and Fault bus protection – Transmission line bedance relay, Translay Relay. STATIC RELAYS AND NUMERICAL PROTECTION Phase, Amplitude Comparators – Synthesis of various relays us	DN e differential rela- on of stator winding rotor fault protecti numerical problem OTECTION protection: Over 0 N	9 ys, bala s by ove on - nur on desi 9 Current, 9 ttors – I of trans	0 unced ervolta merica gn of 0 0 Carrie	0         earth         age re         l prol         CTs r         0         er Cu         0         diagra         on lin	9 -fau lays blem ratio 9 rren 9 am c e.

Te	xt Books:
1.	Sunil S. Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, Fourth Edition, 2010.
2.	Badri Ram and D.N. Vishwakarma, "Power System Protection and Switchgear", Tata McGraw Hill, 2015.
3.	A. Chakrabarti, M. L. Soni, P. V. Gupta and Bhatnagar, "A Text Book on Power System Engineering", Dhanpat Rai &
5.	Co. (Pvt.) Ltd., Delhi, Second Revised Edition 2017.
4.	B.Ravindranath and N. Chander, "Power System Protection and Switchgear", New Age International (P) Ltd, Second
4.	Edition, 2018.
Re	ference Books:
1.	Arun Ingole, "Switchgear and Protection", Pearson Education India, 2017.
2.	T.S. Madhav Rao, "Power System Protection Static Relays with Microprocessor Applications", Tata McGraw-Hill,
۷.	1998.
3.	Y.G. Paithankar and S.R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India Private Ltd, New
5.	Delhi, 2010.
4.	C.L.Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Ltd., 2010.
<b>E-</b> ]	References:
1.	NPTEL Course: Power System Protection - Prof. S.A. Soman, IIT-B.
2.	NPTEL Course: Power System Protection – organized by IIT-B.
3.	www.cdeep.iitb.ac.in. (Electrical Engineering)

Cours	se (	Dutcomes:	Bloom's Taxonomy
Upon completion of this course, the students will be able to:			Mapped
CO1	:	Analyse the characteristics and functions of protective relays.	L3: Applying
CO2	:	Acquire knowledge on functioning of circuit breaker.	L2: Understanding
CO3	:	Assess the protection schemes of alternator and transformer.	L1: Remembering
CO4	:	Assess the protection schemes of motor, bus bar and transmission lines.	L1: Remembering
CO5	:	Develop the knowledge on static and numeric type relays.	L4: Analysing

23PTEE503 ELECTRICAL DRIVES AND CONTROL		OL	SEMESTER			V	
PRI	EREQ	UISITES	CATEGORY	РС	Cre	edit	3
DC	Machin	es and Transformers, Synchronous and Induction Machines, and	Hours / Week	L	Т	Р	TH
Pow	er Elect	ronics	Hours / week	3	0	0	3
Cou	ırse Ol	ojectives:					
1.	To kı	now about the analyze the operation of the chopper fed dc drive, bo	th qualitatively and	quantita	tively	<i>.</i>	
2.	To u	nderstand the operation and performance of AC motor drives.					
	IT I	DC MOTOR CHARACTERISTICS & CHOPPER FEI		9	0	0	9
		orque-speed characteristics of separately excited dc motor, change i					-
		d torque-speed characteristics, operating point, armature voltage co					
-	-	duty ratio control, chopper fed dc motor for speed control, steady sta	te operation of a cho	opper fee	d driv	e, arm	lature
curre	ent wav	eform and ripple, calculation of losses in dc motor and chopper.					
TINI	гт тт	MULTI OLIADDANT & CLOSED LOOD CONTDOL		9	0	•	0
	IT II	MULTI-QUADRANT & CLOSED-LOOP CONTROL		-	0	0	<b>9</b>
		Four quadrant operation of dc machine; single-quadrant, two-qua DC drive, inner current loop and outer speed loop, dynamic model o	-				
		nodeling of chopper as gain with switching delay, plant transfer fu	•	-			
		d controller specification and design.	metion, current con	uoner s	peen	icatio	li anu
desi	Sii, spee	d controller specification and design.					
UN	IT III	INDUCTION MOTOR CHARACTERISTICS		9	0	0	9
		aduction motor equivalent circuit and torque-speed characteristic, va	riation of torque-spe	ed curv	-		-
		applied frequency and (iii) applied voltage and frequency. Revi					-
		f three-phase PWM signals, constant V/f control of induction moto		U			,
UN	IT IV	CONTROL OF SLIP RING INDUCTION MOTOR		9	0	0	9
Imp	act of ro	otor resistance of the induction motor torque-speed curve, operation	n of slip-ring induc	tion mot	tor wi	ith ex	ternal
roto	r resista	nce, starting torque, power electronic based rotor side control of slip	p ring motor, slip po	ower rec	overy	<i>.</i>	
UN	IT V	CONTROL OF SRM AND BLDC MOTOR DRIVES.		9	0	0	9
SRM	1 const	ruction - Principle of operation - SRM drive design factors-To	rque controlled SF	RM- Blo	ock d	iagrai	m of
		is Torque control using current controllers and flux controllers.		-	-		
		hine -Sensing and logic switching scheme-Sinusoidal and trapezo	oidal type of Brush	less dc 1	motor	s - E	lock
diag	ram of c	current controlled Brushless dc motor drive					
			<b>T</b> ( ) ( <b>/</b>			<b>-</b> D	• •
			Total (45	L + 01	<sup>•</sup> ) = 4	5 Pe	riods
Tex	t Book	s:					
1.		Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1					
2.		shnan, "Electric Motor Drives: Modeling, Analysis and Control", P					
3.		ose, "Modern Power Electronics and AC Drives", Pearson Educati	on, New Delhi, 201	0.			
Ref	-	Books:					
1.		Dubey, "Fundamentals of Electrical Drives", CRC Press, 2012.					
2.	2. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.						

## **E-Reference:**

1. https://www.iith.ac.in/~ketan/drives.html

Cours	se (	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Understand the characteristics of dc motors and induction motors.	L2: Understanding
CO2	:	Summarize the operation of chopper fed DC drives.	L4: Analyzing
CO3	:	Understand the principles of speed-control of dc motors and induction motors.	L2: Understanding
CO4	:	Identify suitable power electronic converters used for dc motor and induction motor speed control.	L3: Applying
CO5	:	Analyze the SRM and BLDC motor drive control.	L4: Analyzing

23PTEE504					ER	V
PREREQUI	SITES	CATEGORY	PC	Cre	edit	3
Electrical Mac	hines, Power Electronics.	Hours / Week	L	Т	Р	TH
		Hours / Week	3	0	0	3
Course Obje						
	the fundamental concepts of special electrical machines.					
2. To selec	et proper special machines based on applications.					
UNIT I	SYNCHRONOUS RELUCTANCE MOTORS		9	0	0	9
	features – Types – Axial and radial air gap motors – Operating	principle – Reluct	-	Phaso	-	ram -
	– Vernier motor.				C	
	PERMANENT MAGNET BRUSHLESS D.C. MOTORS		9	0	0	9
	peration – Types – Magnetic circuit analysis – EMF and torqu	e equations – Pov	wer co	ntrolle	ers – l	Motor
characteristics	and control.					
UNIT III	PERMANENT MAGNET SYNCHRONOUS MOTORS		9	0	0	9
	eration – EMF and torque equations – Reactance – Phasor diagra		-	v		-
	ments – Torque speed characteristics - Microprocessor based con			conv		1 010
* *						
UNIT IV	SWITCHED RELUCTANCE MOTORS		9	0	0	9
	features - Principle of operation - Torque prediction - Po	ower controllers -	Non-	linear	analy	vsis –
Microprocesso	r based control - Characteristics – Computer control.					
	STEDDING MOTODS		9	0	0	0
	<b>STEPPING MOTORS</b> features – Principle of operation – Variable reluctance motor	Unhaid motor		0	0	9
	- Theory of torque predictions – Linear and non-linear analysis –	•	-			STACK
configurations	Theory of torque predictions Efficat and non-initial analysis			incurte	,	
		Total (45	$\mathbf{L} + 0$	T) = 4	45 Pe	riods
		X		,		
Text Books:						
1. T.J.E. Mi	ller, "Brushless Permanent Magnet and Reluctance Motor Drives	", Clarendon Press	, Oxfoi	rd, 198	39.	
	nley, "Stepping Motors – A Guide to Motor Theory and Practice"	', Peter Perengrinu	s, Lond	lon, 19	982.	
Reference Bo	ooks:					
1. R. Krishr	an, "Switched Reluctance Motor Drives", CRC Press, 2001.					
	an, "Permanent Magnet Synchronous and Brushless DC Motor D	rives", CRC Press	, 2010.			
E-Reference						
	linecourses.nptel.ac.in					
	ass-central.com					
	poc-list.com					

Cour	se	Bloom's Taxonomy	
Upon	Upon completion of this course, the students will be able to:		Mapped
CO1	:	Explain the principles behind the different special machines.	L2: Understanding
CO2	:	Apply the electromagnetic concepts for development of EMF and Torque in machines.	L3: Applying
CO3	:	Select the control structure in terms of hardware to control the special machines.	L4: Analyzing
CO4	:	Analyze appropriate control techniques for efficient control of special machines.	L4: Analyzing
CO5	:	Develop strategy and methods to implement suitable application-based projects.	L2: Understanding

23P	23PTEE505 POWER ELECTRONICS AND DRIVES LABORATORY				ГER	V
PRE	REQUISITI	ES CATEGORY	PC Cr		edit	1.5
Electr	rical Machines	, Power Electronics Hours / Weel	L	Т	Р	TI
		Hours / Week	0	0	3	3
Cou	rse Object	ives:				
Γo st	udy, analyse	the performance of different power electronic converter circuits and learn to si	mulate	diffe	rent j	pow
		circuits and analyze their performance.				
LIS	T OF EXPE	CRIMENTS:				
1.	Characterist	cs of power diode and SCR				
2.	Static and Sv	witching Characteristics of Power MOSFET				
3.	Static and Sv	vitching Characteristics of Power IGBT				
4.	Single phase	AC to DC fully controlled converter				
5.	Step down a	nd step-up chopper				
6.	IGBT based	single-phase PWM inverter				
7.	IGBT based	three-phase PWM inverter				
8.	TRIAC base	d single phase AC voltage controller				
9.	Speed contro	ol of separately excited chopper fed DC Drive.				
10.	V/f speed co	ntrol method of Three phase Induction Motor.				
11.	Speed contro	ol of BLDC Motor.				
12.	Speed contro	ol of Switched Reluctance Motor				
I		Total (0T+	45P) =	45	Peri	ods
Dofo	rence Books	· · · · · · · · · · · · · · · · · · ·	,			

	M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, PHI Third Edition, New Delhi, 2009.
2.	P.S. Bimbra, "Power Electronics", Khanna Publishers, New Delhi 2016.
3.	Seung-Ki Sul, "Control of Electric Machine Drive Systems", John Wiley & Sons, Ltd., 2011.

Cour	se (	Outcomes:	Bloom's Taxonomy
Upon	con	Mapped	
CO1	:	Analyze the characteristics of MOSFET, SCR and IGBT.	L1: Analyzing
CO2	:	Demonstrate the performance of DC-DC Converters.	L3: Applying
CO3	:	Demonstrate the performance of DC-AC Converters.	L3: Applying
CO4	:	Analyze the performance characteristics of Power Converters for DC and AC Drive.	L4: Analyzing
CO5	:	Analyze the performance characteristics of Power Converters for Special Electrical Machine.	L5: Evaluating

23P	<b>FEE60</b> 1	1	POWER SYSTEM OPERATION AND CO	NTROL	SEN	1EST	<b>FER</b>	VI
PRE	REQU	ISI	TES	CATEGORY	PC	Cr	edit	3
Powe	er Gener	ratic	on, Transmission and Distribution Systems; Power System	Hours / Week	L	Т	Р	TH
Anal	ysis and	Sta	bility	Hours / week	3	0	0	3
Cou	rse Obj	ject	ives:					
1.	To fami	iliar	ize the significance of power system operation and control.					
2.	To unde	ersta	and the concepts of real power - frequency control, and reactive	ve power – voltage co	ontrol.			
3.	To acqu	iire	knowledge on economic power system operations, and compu-	iter aided control of j	powers	syster	n.	
UNI	ΤI	0	VERVIEW OF POWER SYSTEM OPERATION AN	ND CONTROL	9	0	0	9
Powe	er scenar	rio i	in Indian grid – National and Regional load dispatching cen	ters – requirements of	of good	l pow	ver sys	tem
neces	ssity of v	olta	age and frequency regulation. System load variation: System lo	ad characteristics, loa	ad curv	ves -d	aily, w	reekly
			l-duration curve, load factor, diversity factor. Reserve requ		-	-		
			concepts of economic dispatch, unit commitment, load shee		deregu	ilatio	n, gov	ernoi
contr	ol, LFC,	, A'	/R, system voltage control and security control - Tariff: chara	cteristics and types.				
TINIT	тп	D			0	0	•	
UNI			EAL POWER - FREQUENCY CONTROL		9	0	0	9
			f speed governing mechanism and modeling: Speed-load c			-		
-			chines in parallel; concept of control area, LFC control of a sin	• •		•		•
			nd controlled cases; Multi-area systems: Two-area system mo	• •			ed cas	e, tie
line v	with freq	luen	cy bias control; state variable model- integration of economic	dispatch control wit	h LFC.			
UNI	T III	R	EACTIVE POWER–VOLTAGE CONTROL		9	0	0	9
Gene	ration a	nd a	absorption of reactive power - basics of reactive power contr	ol – Automatic Volt	age Re	gulat	or (A	VR) -
brush	iless AC	C ex	citation system – block diagram representation of AVR lo	op - static and dyna	mic an	alysi	s – sta	bility
comp	pensatior	n – v	voltage drop in transmission line - methods of reactive power in	njection - tap changir	ig trans	form	er, SV	C and
STA	TCOM f	for v	voltage control.					
					1	T	1	T
	TIV		CONOMIC DISPATCH AND UNIT COMMITMEN		9	0	0	9
			onomic dispatch problem - input and output characteristics of	-				
	-		ons with and without loss, solution by direct method and Lan	bda -iteration metho	d (No	deriva	ation c	f los
			se point and participation factors method.					
			t Commitment problem- Constraints in Unit Commitment: spin	•				•
			constraints and other constraints; Unit Commitment soluti					
dyna	mic prog	gran	nming approach, numerical problems only in priority-list meth	nod using full-load av	verage	produ	iction	cost.
UNI	тv	C	OMPUTER CONTROL OF POWER SYSTEMS		9	0	0	9
			Energy control centre functions: Monitoring, data acquisitio	n and control energy				
			hardware configuration –master station-remote terminal	-				
	-		ate estimation, security analysis and control - Various operati				-	
			State transition diagram showing various state transitions and e	-		- 5011	., em	
		., .		0				
				Total (45	L + 07	C) = 4	45 Pe	riod
						-,	0	

Tex	t Books:				
1	Allen J. Wood and Bruce F.Wollenberg, "Power Generation, Operation and Control", Wiley India Ltd, New				
1.	Delhi, Second Edition, Reprint 2016.				
	Olle. I. Elgerd, "Electric Energy Systems Theory - An Introduction", Tata McGraw Hill Publishing				
2.	Company Ltd, New Delhi, 34 <sup>th</sup> reprint 2010.				
3.	P. Kundur, "Power System Stability & Control", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10 <sup>th</sup>				
5.	reprint 2010.				
Ref	Reference Books:				
1.	D,P. Kothari, and I.J. Nagrath, "Modern Power System Analysis", Fourth, Tata McGraw Hill Education				
1.	Pvt., Limited, New Delhi, 2011.				
2.	L.L. Grigsby, "The Electric Power Engineering, Hand Book", CRC Press & IEEE Press, 2001.				
3.	B.M. Weedy and B.J. Cory, "Electric Power systems", Wiley, 2012.				

Cours	se (	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Recognize the fundamentals of power system operation and control.	L2: Understanding
CO2	:	Interpret the control action to meet the real power demand variations.	L3: Applying
CO3	:	Employ the reactive power injections for voltage profile improvement.	L3: Applying
CO4	:	Formulate the economic scheduling problems in power system.	L4: Analysing
CO5	:	Examine the need of computer aided control for power system operations and control.	L4: Analysing

23]	PTEE602	3PTEE602 UTILIZATION OF ELECTRICAL ENERGY				'ER	VI
PR	EREQUIS	ITES	CATEGORY	PC	Cre	edit	3
Ele	ctrical Machi	ines, Power System, Power Electronics	Hours / Week	L 3	<u>Т</u> 0	<u>Р</u> 0	<u>TH</u> 3
Co	urse Objec	tives:	I			,	
1.	To under	stand the economics of generation, tariff, and energy conservati	on methods.				
2.	To impar	t knowledge on principle and design of illumination systems.					
3.	To analyz	ze the performance and different methods of electric heating and	d electric welding.				
4.	-	t knowledge on electric traction systems and their performance.					
5.		stand electric drives for various industrial applications.					
UN	IT I I	NTRODUCTION		9	0	0	9
	-	eneration – definitions – load duration curve – number and size of	•				
		bility Based Tariff (ABT) – Battery Energy Storage System (BE		used ene	ergy n	neasur	rement
- No	eed for electr	ical energy conservation – methods- Introduction to Energy Au	ıdit				
		LLUMINATION		9	0	0	9
		ure of radiation – definition – laws of illumination – luminous	afficacy photomati	-			
		anation systems for residential, commercial, street lighting and s	• •		-		
	-	vapour –fluorescent lamp-energy efficiency lamps – types of			-		
	ting	upour musicescent music chergy enterency musices of	ingitting senemies	requ			5000
U	U						
	-	IEATING AND WELDING		9	0	0	9
UN	IT III H	<b>IEATING AND WELDING</b> assification of methods of heating – requirements of a good heating	ating material – des	-	-	•	-
UN Intr	IT III H oduction- cla		-	sign of	heatin	ng eler	nent –
UN Intr tem	IT III H oduction- cla perature con	assification of methods of heating - requirements of a good heating	ing – dielectric hea	sign of ating –	heatin	ng eler	nent –
UN Intr tem resi	IT III H oduction- cla perature con stance weldi	assification of methods of heating – requirements of a good heatrol of resistance furnace – electric arc furnace – induction heat ng – electric arc welding-electrical properties of arc-application	ing – dielectric hea	sign of ating – elding.	heatin	ng eler ic wel	nent – ding –
UN Intr tem resi UN	IT III     H       oduction- cla       perature con       stance weldi       IT IV	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application ELECTRIC TRACTION	ing – dielectric hea as of electric arc we	sign of sting – side sting – side strang – side strang stranger st	heatin electri	ng eler ic wel	nent – ding – 9
UN Intr tem resi UN Intr	IT III     H       oduction- cla       perature con       stance weldi       IT IV       E       oduction – re	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train	ing – dielectric hea as of electric arc we n movement -mecha	sign of ating – elding. 9 anism o	heatin electri 0	ng eler ic wel 0 n mov	nent – ding – 9 rement
UN Intr tem resi UN Intr – tr	IT III     H       oduction- cla       perature con       stance weldi       IT IV       E       oduction – re       action motor	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- m	ing – dielectric hea as of electric arc we n movement -mecha	sign of ating – elding. 9 anism o	heatin electri 0	ng eler ic wel 0 n mov	nent – ding – 9 rement
UN Intr tem resi UN Intr – tr	IT III     H       oduction- cla       perature con       stance weldi       IT IV       E       oduction – re	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace – induction heat ng – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- m	ing – dielectric hea as of electric arc we n movement -mecha	sign of ating – elding. 9 anism o	heatin electri 0	ng eler ic wel 0 n mov	nent – ding – 9 rement
UN Intr tem resi UN Intr – tr in e	IT III     H       oduction- cla       perature con       stance weldi       IT IV       E       oduction – re       action motor       lectric tractic	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application <b>ELECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- mon.	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control	sign of ating – elding. 9 anism o	heatin electri 0	ng eler ic wel 0 n mov	nent – ding – 9 rement
UN Intr tem resi UN Intr – tr in e UN	IT III     H       oduction- cla       perature con       stance weldin       IT IV     E       oduction – re       action motor       lectric tractio       IT V     D	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- mon. <b>PRIVES AND THEIR INDUSTRIAL APPLICATION</b>	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control S	sign of tting – elding. 9 anism o – braki	heatin electri of train ng – r	ng eler ic wel 0 n mov recent 0	nent – ding – 9 rement trends 9
UN Intr tem resi UN Intr – tr in e UN Ele	IT III       H         oduction- cla         perature con         stance weldi         IT IV       E         oduction – ra         action motor         lectric traction         IT V       D         ctric drive –a	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace –induction heat ng – electric arc welding-electrical properties of arc-application <b>ELECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- mon.	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control <b>S</b> actors affecting sele	9 anism of blding. 9 anism o - braki 9 sction o	0 0 0 0 0 0 0 0 f moto	0 n mov recent 0 or – ty	nent – ding – 9 rement trends 9 rpes of
UN Intr tem resi UN Intr – tr in e UN Elec load	IT III       H         oduction- cla         perature con         stance weldi         IT IV       E         oduction – re         action motor         lectric traction         IT V       D         ctric drive –a         ds – steady st	assification of methods of heating – requirements of a good heat trol of resistance furnace – electric arc furnace – induction heat ng – electric arc welding-electrical properties of arc-application <b>ELECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- mon. <b>PRIVES AND THEIR INDUSTRIAL APPLICATION</b> idvantages of electric drive-individual drive and group drive –fa	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control <b>S</b> actors affecting sele – industrial applica	sign of tting – v elding. 9 anism o – braki 9 ection o ations –	0 0 0 0 0 0 0 0 f moto	0 n mov recent 0 or – ty	nent – ding – 9 rement trends 9 rpes of
UN Intr tem resi UN Intr – tr in e UN Elec load	IT III       H         oduction- cla         perature con         stance weldi         IT IV       E         oduction – re         action motor         lectric traction         IT V       D         ctric drive –a         ds – steady st	Assification of methods of heating – requirements of a good heating of resistance furnace – electric arc furnace – induction heating – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – trainest and control –speed control of three phase induction motor- methon. <b>DRIVES AND THEIR INDUSTRIAL APPLICATION</b> edvantages of electric drive-individual drive and group drive –fatate –transient characteristics –size of motor– load equalization	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control <b>S</b> actors affecting sele – industrial applica raking using thyrist	9 anism of blding. 9 anism of braki 9 section o ations - fors.	0 of train ng – r 0 f moto- mod	0 n mov recent 0 or – ty ern m	nent – ding – 9 ement trends 9 vpes of ethods
UN Intr tem resi UN Intr – tr in e UN Elec load	IT III       H         oduction- cla         perature con         stance weldi         IT IV       E         oduction – re         action motor         lectric traction         IT V       D         ctric drive –a         ds – steady st	Assification of methods of heating – requirements of a good heating of resistance furnace – electric arc furnace – induction heating – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – trainest and control –speed control of three phase induction motor- methon. <b>DRIVES AND THEIR INDUSTRIAL APPLICATION</b> edvantages of electric drive-individual drive and group drive –fatate –transient characteristics –size of motor– load equalization	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control <b>S</b> actors affecting sele – industrial applica	9 anism of blding. 9 anism of braki 9 section o ations - fors.	0 of train ng – r 0 f moto- mod	0 n mov recent 0 or – ty ern m	nent – ding – 9 ement trends 9 vpes of ethods
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UN Intr resi UN Intr – tr in e UN Elec of s	IT III       H         oduction- cla         perature con         stance weldit         IT IV       E         oduction – re         action motor         lectric tractic         IT V       D         ctric drive –a         ds – steady st         peed control	assification of methods of heating – requirements of a good heatrol of resistance furnace – electric arc furnace – induction heat ng – electric arc welding-electrical properties of arc-application <b>CLECTRIC TRACTION</b> equirements of an ideal traction system – supply systems – train s and control –speed control of three phase induction motor- mon. <b>PRIVES AND THEIR INDUSTRIAL APPLICATION</b> idvantages of electric drive-individual drive and group drive –fa tate –transient characteristics –size of motor– load equalization of D.C drives-dynamic braking using thyristors-regenerative br	ing – dielectric hea as of electric arc we n movement -mecha ultiple unit control S actors affecting sele – industrial applica raking using thyrist Total (45	9 anism of blding. 9 anism of braki 9 section o ations - cors. 5L + 0	$\begin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ $	0 n mov recent 0 or – ty ern m	nent – ding – 9 ement trends 9 vpes of ethods eriods
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2.	H. Partab, "Art and Science of Utilization of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.					
E-R	E-References:					
1.	www.onlinecourses.nptel.ac.in					
2.	www.class-central.com					
3.	www.mooc-list.com					

Cour	se (	Outcomes:	Bloom's Taxonomy	
Upon	Upon completion of this course, the students will be able to:			
CO1	:	Understand the economics of generation, tariff, and energy conservation methods.	L2: Understanding	
CO2	:	Interpret the concept behind illumination and design a suitable illumination system for a specific application.	L3: Applying	
CO3	:	Design and choose an appropriate heating method for specific application and gain knowledge about electric welding system.	L4: Analyzing	
CO4	:	Explain the concepts and recent trends of traction system.	L4: Analyzing	
CO5	:	Discuss the concepts of electric drives and their characteristics.	L2: Understanding	

23PTEE603		SOLAR AND WIND ENERGY CONVERSION	SYSTEMS	SEMESTER VI PC Credit 3						
PRER	EQUIS	ITES	CATEGORY	L T P						
Enginee	ering Ph	ysics, Electrical Machines and Power Electronics	Hours / Week				TH			
	-			3	0	0	3			
Course	Course Objectives:									
1.	To unc	erstand the concepts of power generation through Solar and W	ind Power							
2.	2. To learn the optimal extraction of renewable power and their integration to grid									
UNIT I FUNDAMENTALS OF SOLAR ENERGY						0	9			
		lar radiation spectra, solar geometry, Earth Sun angles, observe	er Sun angles, solar	9 dav lei	0 19th. E					
		ailability.		j	8° ,					
UNIT		FUNDAMENTALS OF WIND ENERGY		9	0	0	9			
-		power, Indian and Global statistics, Wind physics, Betz limit,	<b>I I</b>	-	oitch co	ontrol	, Wind			
speed st	tatistics-	probability distributions, Wind speed and power-cumulative di	istribution functions	5.						
UNIT	ш	SOLAR PHOTOVOLTAICS		9	0	0	9			
		morphous, monocrystalline, polycrystalline; V-I characterist	ics of a PV cell F	-						
	-	verters for Solar Systems, Maximum Power Point Tracking				-				
		nverter Control.	5 (1111 100, 1	nerenit		ondu	stunce)			
uigoitui										
UNIT	IV	WIND GENERATOR TOPOLOGIES		9	0	0	9			
Review	of mod	ern wind turbine technologies, Fixed and Variable speed wind	turbines, Induction	Genera	tors, I	Doubl	y-Fed			
Inductio	on Gene	ators and their characteristics, Permanent-Magnet Synchronou	is Generators, Powe	er conv	erters.	Gene	rator-			
Conver	ter confi	gurations, Converter Control.								
UNIT	-	GRID INTEGRATION		9	0	0	9			
	-	id code technical requirements. Fault ride-through for wind			-	-				
-		juency operating limits, solar PV and wind farm behavior dur			-	•				
Power s	system i	nterconnection experiences in the world. Hybrid and isolated of	perations of solar P	V and	wind s	ystem	IS.			
			Tatal (A	<u>51   (</u>	) <u> </u>	45 D	miada			
			Total (4	3L + (	<b>)1</b> ) –	431	erious			
Text B	Books:									
	hetan Si	ngh Solanki, "Solar Photovoltaics Fundamentals, Technologi	es and Application	s", PH	I Lear	ning	Private			
1. Limited, New Delhi, 2009.										
		hra, "Power Electronics", Khanna Publishers, New Delhi, 4th		0.10						
		nid, "Power Electronics: Circuits, Devices and Applications", I	Pearson, 3rd Edition	n, 2013	•					
Refere	ence Bo	oks:								
1. G	.D. Rai,	"Non-Conventional Energy Sources", Khanna Publishers, Nev	v Delhi, 2011.							
		sters, "Renewable and Efficient Electric Power Systems", John	-							
3. G	3. G. N. Tiwari and M. K. Ghosal, "Renewable Energy Applications", Narosa Publications, 2004.									

4.	H. Siegfried and R. Waddington, "Grid integration of wind energy conversion systems" John Wiley India Sons
	Ltd.,2006.
5.	N. Mohan et al. "Power Electronics: Converters, Application and Design", Wiley India (P) Ltd, New Delhi, 2008.
<b>E</b> –	References:
1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com

Cours	se (	Dutcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the physics behind the solar and wind power generation.	L2: Understanding
CO2	:	Implement the optimal extraction techniques in renewable power generation.	L3: Applying
CO3	:	Apply power electronics to renewable power optimization.	L3: Applying
CO4	:	Understand integration techniques used, power quality issues and their mitigation.	L2: Understanding
CO5	:	Device methods to create an approximate energy conversion systems.	L6: Creating

23PTEE701 HIGH VOLTAGE ENGINEER	RING	SEN	AEST	ΓER	VII
PREREQUISITES	CATEGORY	PC	Cr	edit	3
Measurements and Instrumentation, Power Generation, Transmission and	nd Hours / Week	L	Т	Р	TH
Distribution system	Hours / Week	3	0	0	3
Course Objectives:					
1. To expose the various types of over voltage transients and their effective of the transient of the transi	fect on power system.				
2. To introduce the concept of insulation co-ordination technique.					
3. To provide an overview of solid, liquid and gaseous dielectrics br					
4. To show how to generate over voltages in the HV testing laborate	•				
5. To show how to measure of high voltage and current quantity in H	HV testing laboratory				
6. To introduce testing procedure of HV power apparatus.					
OVED VOLTACES IN ELECTRICAL DOWED	ONCERTING AND				
UNIT I OVER VOLTAGES IN ELECTRICAL POWER INSULATION CO-ORDINATION	SISIEWIS AND	9	0	0	9
Causes of over voltages and its effect on power system – Lightning Reflection and Refraction of travelling waves – Bewley lattice diag	• •	-	•		-
· · ·		ver voi	tages;	Princi	ipie o
Insulation Coordination on High voltage and Extra high voltage power	systems.				
UNIT II DIELECTRIC BREAKDOWN		9	0	0	9
		-	-	-	-
Properties of Dielectric materials- Gaseous breakdown in uniform and			0		
breakdown - Conduction and Breakdown in pure and commercial liquid	is dielectrics – Breakdow	n mech	antem		id an
			amsm	5 11 50	ina an
composite dielectrics- Application of insulating materials in electrical e	quipment.		amsm	IS 111 SO	ila uli
			1		
UNIT III GENERATION OF HIGH VOLTAGES AND H	IGH CURRENTS	9	0	0	9
UNIT III GENERATION OF HIGH VOLTAGES AND H Generation of High DC voltages: Rectifiers, voltage multipliers and	IGH CURRENTS Van de Graff generator	<b>9</b> - Gene	<b>0</b> ration	<b>0</b> of Hig	<b>9</b> gh A <b>0</b>
UNIT III GENERATION OF HIGH VOLTAGES AND H Generation of High DC voltages: Rectifiers, voltage multipliers and voltages: cascaded transformer, resonant transformer and tesla coil-	IGH CURRENTS Van de Graff generator Generation of High imp	9 - Gener ulse vo	0 ration ltages	<b>0</b> of Hig : sing	<b>9</b> gh A0 le an
UNIT III GENERATION OF HIGH VOLTAGES AND H Generation of High DC voltages: Rectifiers, voltage multipliers and voltages: cascaded transformer, resonant transformer and tesla coil- multistage Marx circuits - Generation of switching voltages - Generation	IGH CURRENTS Van de Graff generator Generation of High imp	9 - Gener ulse vo	0 ration ltages	<b>0</b> of Hig : sing	<b>9</b> gh A0 le an
UNIT III GENERATION OF HIGH VOLTAGES AND H Generation of High DC voltages: Rectifiers, voltage multipliers and voltages: cascaded transformer, resonant transformer and tesla coil- multistage Marx circuits - Generation of switching voltages - Generation	IGH CURRENTS Van de Graff generator Generation of High imp	9 - Gener ulse vo	0 ration ltages	<b>0</b> of Hig : sing	<b>9</b> gh A( le an
Generation of High DC voltages: Rectifiers, voltage multipliers and voltages: cascaded transformer, resonant transformer and tesla coil- multistage Marx circuits - Generation of switching voltages - Generation generators.	IGH CURRENTS Van de Graff generator Generation of High imp of impulse currents. Trip	<b>9</b> - Generulse vo ping and	0 ration ltages l contr	0 of Hiş : sing rol of in	<b>9</b> gh A( le and npuls
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UNIT III         GENERATION OF HIGH VOLTAGES AND H           Generation of High DC voltages: Rectifiers, voltage multipliers and voltages: cascaded transformer, resonant transformer and tesla coil-multistage Marx circuits - Generation of switching voltages - Generation generators.           UNIT IV         MEASUREMENT OF HIGH VOLTAGES AND           Measurement of high DC, AC, impulse voltages – Measurement of high         Measurement of high	IGH CURRENTS Van de Graff generator Generation of High imp of impulse currents. Trip HIGH CURRENTS	9 Generation ulse vo ping and 9	0 ration ltages l contr	0 of Hig : sing rol of in 0	9 gh AC le and npuls 9
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3.	Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd
	Publishers, Third Edition, 2006.
E-re	eferences:
1.	www.onlinecourses.nptel.ac.in/noc18_ee41
2.	NPTEL courses on High Voltage Engineering, IIT Kanpur.

## **Course Outcomes:**

Cour	se	Outcomes:	Bloom's Taxonomy
Upon	con	npletion of this course, the students will be able to:	Mapped
CO1	:	Explain the various over voltages and its effect on power system.	L2: Understanding
CO2	:	Understand high voltage breakdown phenomena in insulating materials.	L2: Understanding
CO3	:	Explain the method of generating high DC, AC and impulse voltages	L3: Applying
CO4	:	Use appropriate procedure for measurement of high DC, AC and impulse currents.	L3: Applying
CO5	:	Comprehend the HV test procedures on electrical apparatus as per the Indian standards.	L2: Understanding

23F	TEE702	2 SMART GRID TECHNOLOGIES		SEMF	ESTEI	R	VII
PR	EREQU	ISITES	CATEGORY	PC	Cre	edit	3
Pow	ver Gener	ation, Transmission and Distribution System	Hours / Week	L	Т	Р	TH
			Hours / Week	3	0	0	3
	urse Obj			-			
1.	To learn grid.	n communication and automation technologies and high-performer	rmance computing	for smar	t opera	tion of	power
TIN	IT I	SMART GRID ARCHITECTURE		9	0	0	0
_		Conceptual model of Smart Grid, Smart Grid architecture and	l Components Sm	-		0 1 Sma	9 rt Grid
		cs, Smart Grid Enabling Technologies, Stages for Grid Modern	-				
UN	TT II	COMMUNICATION AND INFORMATION SECU	DITV	9	0	0	9
		s of Smart Grid Communications, Communication infrast			-		
tech		for Smart Grid, Information Layer of Smart Grid, SG Securit					
UN	TT III	CONTROL AND AUTOMATION TECHNOLOGI	ES	9	0	0	9
		ng: Benefits, Architecture, Key components and operation, co		hitecture			-
Den	nand-side	integration (DSI): Definitions and services provided by DSI,	Substation automa	tion equi	ipment	: archi	tecture,
com	ponents a	nd functions, Intelligent electronic devices (IED), Relay IED,	Bay controller.				
				1	1	1	1
UN	IT IV	SMART TRANSMISSION AND DISTRIBUTION MANAGEMENT SYSTEMS		9	0	0	9
Stru	icture of	Energy management systems- Phasor Measurement Unit (I	PMU) - Wide-Are	a Measu	iremen	t (WA	M) for
		Systems- Structure and main components of Distribution Man	agement System- S	Superviso	ory Cor	ntrol aı	nd Data
Acq	uisition (	SCADA)- Customer information system					
-				1	1		
UN	IT V	CLOUD COMPUTING AND DATA MANAGEME	NT IN SMART	9	0	0	9
D.1		GRID			Т. т		C
	-	between Smart Grid, cloud computing, and big data, Cloud Computing Service Models, Cloud computing platform coupled			-	-	
		, Privacy Information Impacts on Smart Grid, Meter Data Man			pilcatic	0115 101	Energy
ivia	lugement		ingement for binnet	Gild			
			Tota	l (45L +	- <b>0</b> T) =	= 45 P	eriods
				-			
Tex	kt Books	:					
1.		Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, an blications", Wiley, 2012	d Akihiko Yokoya	ma, "Sma	art Gric	l: Tech	nology
2.		orlase, "Smart Grids Advanced Technologies and Solutions",	Second Edition, C	RC, 201	8.		
	·						
Ref	ference I						
1.	James N	Iomoh, "Smart Grid Fundamentals of Design and Analysis", V	Wiley, 2012.				
E-F	Referenc						
1.	https://a	rchive.nptel.ac.in/courses/108/107/108107113/					

Cours	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Describe the Smart Grid modernization process and its present developments.	L1: Remembering
CO2	:	Select the suitable communication networks for smart grid applications.	L4: Analyzing
CO3	:	Use a suitable smart device for Smart Grid operation.	L3: Applying
CO4	:	Illustrate a smart transmission and distribution system using PMU, WAM and SCADA.	L4: Analyzing
CO5	:	Explain the need of high end computing and big data analytics in smart grid.	L2: Understanding

	THS7	01	INDUSTRIAL MANAGEMENT A	ND ECONOMICS		SEN	MEST	<b>TER</b>	VII
PR	EREQ	UISITE		CATEGO	RY	HS	Cr	edit	3
Mat	hematic	es		Hours / W	eek	L 3	<u>Т</u> 0	P 0	<u>TH</u> 3
Coi	irse O	bjective				v	v	v	U
1.		U	the concept of management, economics and I	ndian financial system					
				•					
UN	IT I	MOD	RN CONCEPT OF MANAGEMENT			9	0	0	9
Sci	entific r	nanagem	nt-Functions of management-Planning- Organ	nising- Staffing-Directin	g- Mo	otivatin	ig- Coi	nmuni	cating
		-	olling-Organizational structures- Line, Line a	and staff and Functional	relat	ionship	os- Spa	an of c	ontro
Dele	egation-	- Manage	ent by Objectives.						
TIN	IT II	DEDC	NNEL MANAGEMENT			9	0	0	0
				t Salaation and training	rofr	-	v		<b>9</b>
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		-	lic sector- Joint sector and Co-operative sector		.s. F10	sprieto	ry-ral	uici 8111	p-101
5100	r comp	unico- 1 U	the sector some sector and co-operative sector	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
UN	IT III	MAR	ETING MANAGEMENT			9	0	0	9
Pric	ing- Pr	omotion-	Channels of distribution- Market research-A	Advertising. Production	Man	agemer	-	tch and	
			control- EOQ-Project planning by PERT/CP						
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IIN									
UI	IT IV	BASI	S OF ECONOMICS			9	0	0	9
			S OF ECONOMICS d supply- Price mechanism- Factors of produ	uction- Land, labour, ca	pital a	-	-	v	9 ation
The	ory of c	demand a				and org	ganizat	ion- N	ation
The inco	ory of c me- Di	demand a	d supply- Price mechanism- Factors of product a stimation- Taxation- Direct and indirect tax			and org	ganizat	ion- N	ation
The inco Cau	ory of c ome- Di ses and	lemand a fficulties conseque	d supply- Price mechanism- Factors of produ a estimation- Taxation- Direct and indirect tax aces.			and org e- Blac	ganizat ek mon	ion- Na ley- Inf	ation latio
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Cours	se O	outcomes:	Bloom's Taxonomy
Upon	comj	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the concepts of management	L2: Understanding
CO2	:	Remember various types of management.	L1: Remembering
CO3	:	Analyze the Indian economics	L4: Analyzing
CO4	:	Create an organization efficiently for its upliftment	L6: Creating
CO5	:	Apply marketing concept to any organization to earn more profit.	L3: Applying

23PTEE801 PROJECT WORK		SEMESTER			VIII	
PREREQUISI	ГЕ	CATEGORY	EEC	Cre	dit	3
	REREQUISITE CATEGO	Houng / Wools	L	Т	Р	TH
		Hours / Week	0	0	6	6
COUDCE ODI						

## **COURSE OBJECTIVES:**

The student should be made to learn methodology to select a good project and able to work in a team leading to development of hardware/software product. Prepare a good technical report. Gain Motivation to present the ideas behind the project with clarity.

## **GUIDELINES AND EVALUATION**

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of any power component / circuit / sensor / Activator / Controller, a research investigation, a computer or management project or a design problem.

The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible, with an industry.

The progress of the project is evaluated for internal assessment based on a minimum of three reviews. The project review committee may be constituted by the Head of the Department. The student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

Total (90P) = 90 Periods

		COUTCOMES: etion of the course the student will be able to	Bloom's Taxonomy Mapped
CO1	:	Ability to identify, formulate, design, interpret, analyze and provide solutions to complex engineering and societal issues by applying knowledge gained on basics of science and Engineering	L6: Creating
CO2	:	Ability to choose, conduct and demonstrate a sound technical knowledge of their selected project topics in the field of power components, protection, high voltage, electronics, process automation, power electronics and drives, instrumentation and control by exploring suitable engineering and IT tools.	L6: Creating
CO3	:	Ability to understand, formulate and propose new learning algorithms to solve engineering and societal problems of moderate complexity through multidisciplinary projects understanding commitment towards sustainable development.	L2: Understanding
CO4	:	Ability to demonstrate, prepare reports, communicate and work in a team as a member/leader by adhering to ethical responsibilities	L6: Creating
CO5	:	Ability to acknowledge the value of continuing education for oneself and to stay up with technology advancements.	L5: Evaluating

	ADVANCED CONTROL SYSTEMS	SEM	EST	ER	VI
PREREQUIS	SITES CATEGORY	PE	Cr	edit	3
Signals and S	ystems, Control systems Hours / Week	L	Т	Р	TH
C .		3	0	0	3
Course Obje					
-	knowledge in the analysis of non-linear system				
2. To gain	knowledge in the analysis of digital control of linear system.				
UNIT I N	ON-LINEAR SYSTEM – DESCRIPTION & STABILITY	9	0	0	9
Linear vs non-	inear - Examples - Incidental and Intentional - Mathematical description - Equ	ilibria a	nd lin	eariza	tion
Stability – Lyaj	ounov function – Construction of Lyapunov function.				
		-			-
	HASE PLANE AND DESCRIBING FUNCTION ANALYSIS	9	0	0	9
	f phase trajectory – Isocline method – Direct or numerical integration – Descr	ibing fui	nction	anal	ysis
Computation of	amplitude and frequency of oscillation.				
UNIT III Z	- TRANSFORM AND DIGITAL CONTROL SYSTEM	9	0	0	9
	ion – Block diagram – Signal flow graph – Discrete root locus – Bode plot.	,	U	U	,
	ion block diagram bignar now graph biserete root rocus bode prot.				
UNIT IV S'	TATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM	9	0	0	9
State equation -	- Solutions – Realization – Controllability – Observability – Stability – Jury's test.	,	U	v	-
State equation -	- Solutions – Realization – Controllability – Observability – Stability – Jury's test.		•	Ŭ	-
-	- Solutions – Realization – Controllability – Observability – Stability – Jury's test. UTLI INPUT MULTI OUTPUT (MIMO) SYSTEM	9	0	0	9
UNIT V M		9	0	0	9
UNIT V M Models of MIN	UTLI INPUT MULTI OUTPUT (MIMO) SYSTEM	9 nd Zeros	0	0	9
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Course Outcomes:		utcomes:	Bloom's Taxonomy		
Upon c	omj	pletion of this course, the students will be able to:	Mapped		
CO1	:	Use the conventional technique of non-linear system analysis.	L2: Understanding		
CO2	:	Solve the problems in digital control systems using Z transform.	L5: Evaluating		
CO3	:	Analyze discrete time systems using conventional techniques.	L3: Applying		
CO4	:	Analyze the digital control system using state-space formulation.	L3: Applying		
CO5	:	Know the formulation and analysis of MIMO systems.	L6: Creating		

23PTEF	3PTEEE12   DISCRETE CONTROL SYSTEMS		SEMESTER			VI	
PREREQUISITES CATEGORY			PE	Credit		3	
Control S	lystems	Но	ours / Week	L	Т	Р	TH
Control 5	systems	110	JUIS / WEEK	3	0	0	3
Course	Object	tives:					
		stand the digital signal processing.					
	•	the design of sampled data control systems in state space.					
3. To	o impart	knowledge on digital control algorithms and stability study.					
UNIT I	IN	NTRODUCTION		9	0	0	9
		ency and time response analysis and specifications of continuous	s time systems		-	contro	llers
	-	compensations - continues time PI, PD, PID controllers, Realization	•				
Lag-Lead	l compe	ensation schemes - problems.					
UNIT II	r G1	IGNAL PROCESSING IN DIGITAL CONTROL		0	0	Δ	0
		control – Configuration of basic digital control scheme – Principles	of signal acre	9		0	<b>9</b>
	0	me domain and frequency domain models for discrete-time systems	0				
0		al aspects of the choice of sampling rate – Discretization based on b	U			on or a	naiog
signals –	Practica	al aspects of the choice of sampling rate – Discretization based on b	onnear transfo	rmation	1.		
orginals							
	M	IODELING AND ANALYSIS OF SAMPLED DATA CON	NTROL				
UNIT II		IODELING AND ANALYSIS OF SAMPLED DATA CON YSTEM	NTROL	9	0	0	9
UNIT II		YSTEM			Ŭ	Ŭ	-
UNIT II Differenti	ial equa	<b>YSTEM</b> ation description – Z-transform method of description– Z-transform a	analysis of sam	pled da	ta con	trol sy	stem
UNIT II Differenti –Jury's st	ial equa tability t	<b>YSTEM</b> ation description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts	analysis of sam ts: First compar	pled da	ta con	trol sy	stem
UNIT II Differenti –Jury's st	ial equa tability t	<b>YSTEM</b> ation description – Z-transform method of description– Z-transform a	analysis of sam ts: First compar	pled da	ta con	trol sy	stem
UNIT II Differenti –Jury's st	ial equa tability t	<b>YSTEM</b> ation description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts	analysis of sam ts: First compar	pled da	ta con	trol sy	oanio
UNIT II Differenti –Jury's st – Jordan o UNIT IN	ial equa tability t canonic	<b>YSTEM</b> tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles.	analysis of sam s: First compar	pled da nion – S	ta con becond	trol sy comp	ostem panio 9
UNIT II Differenti –Jury's st – Jordan d UNIT IV Introducti	$ \begin{array}{c c} \mathbf{I} & \mathbf{S} \\ \text{ial equa} \\ \text{iability t} \\ \text{canonic} \\ \hline \mathbf{V} & \mathbf{D} \\ \text{ion} - \mathbf{z} \\ \end{array} $	YSTEM ation description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS	analysis of sam s: First compar	pled da nion – S 9 ompensa	ta con decond 0 ator d	trol sy 1 comp 0 esign	vstem panio 9 using
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency	ial equa tability t canonic V D ion – z- y respon	YSTEM attion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a	analysis of sam s: First compar	pled da nion – S 9 ompensa	ta con decond 0 ator d	trol sy comp 0 esign	vstem panio 9 using
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller	II SY ial equa tability t canonic V D ion – z- y respon rs for de	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples.	analysis of sam as: First compar and lag-lead co as plots – z-pl	pled da nion – S 9 ompensa lane sy:	ta condecond	trol sy comp comp esign s – D	stem panio 9 using igital
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V	II     SY       ial equa     equa       tability t     canonic       V     D       ion - z-     y respondence       y respondence     r       rs for decomposition     P	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO	analysis of sam as: First compar and lag-lead co as plots – z-pl	pled da nion – S 9 ompensa lane sy:	ta condecondo econdo ator d nthesi	ttrol sy 1 comp 0 esign ls – D	stem panio 9 using igita 9
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developn	II     SY       ial equa     equa       tability t     canonic       V     D       ion - z-     y response       y response     for detection       r     P       nent and	YSTEM ation description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c	analysis of sam analysis of sam s: First compar und lag-lead co us plots – z-pl DRITHMS controllers - Di	pled da nion – S 9 ompensa lane sy: gital te	ta cond second dator d nthesi 0 mpera	0 esign s – D o ature c	9 using 9 ontro
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developm system: C	II     SY       ial equa     equa       tability t     canonic       V     DY       ion - z-     z       y response     r       r     PI       nent and     Control a	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of	analysis of sam as: First compar and lag-lead co as plots – z-pl DRITHMS controllers - Di f shaft position	pled da nion – S <b>9</b> ompensa lane sy: <b>9</b> igital te /speed,	ta cond ta cond decond ator d nthesi <b>0</b> mpera contr	0 esign s – D o ature c	9 using 9 ontro
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developm system: C	II     SY       ial equa     equa       tability t     canonic       V     DY       ion - z-     y response       y response     r       r     PI       nent and     Control a	YSTEM ation description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c	analysis of sam as: First compar and lag-lead co as plots – z-pl DRITHMS controllers - Di f shaft position	pled da nion – S <b>9</b> ompensa lane sy: <b>9</b> igital te /speed,	ta cond ta cond decond ator d nthesi <b>0</b> mpera contr	0 esign s – D o ature c	9 using 9 ontro
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developm system: C	II     SY       ial equa     equa       tability t     canonic       V     DY       ion - z-     y response       y response     r       r     PI       nent and     Control a	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of	analysis of sam analysis of sam s: First compar- und lag-lead co us plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position notors to microp	pled da nion – S <b>9</b> mpensa lane sy: gital te /speed, process	ta cond decond decond ator d nthesi <b>0</b> mpera contr ors	0 esign s – D 0 ature c ol algo	9 using igita 9 ontro prithr
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UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developn system: C – Steppin	II     SY       ial equa     iability t       tability t     canonic       V     DY       ion - z-     z       y response     r       r     PI       nent and     and       control and     and	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of	analysis of sam analysis of sam s: First compar- und lag-lead co us plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position notors to microp	pled da nion – S <b>9</b> mpensa lane sy: gital te /speed, process	ta cond decond decond ator d nthesi <b>0</b> mpera contr ors	0 esign s – D 0 ature c ol algo	9 usiną igita 9 ontro
UNIT II Differenti –Jury's st – Jordan o UNIT IV Introducti frequency controller UNIT V Developm system: C – Steppin Text Boo	II SY ial equa tability t canonic V D ion – z- y respon rs for de P ment and Control a g motor	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of	analysis of sam as: First compar- and lag-lead co as plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position totors to microp <b>Total (4</b>	pled da nion – S 9 ompensa lane sy: gital te /speed, process 5L + 0	ta cond decond decond ator d nthesi <b>0</b> mpera contr ors	0 esign s – D 0 ature c ol algo	9 usiną igita 9 ontro
UNIT II Differenti –Jury's st – Jordan d UNIT IV Introducti frequency controller UNIT V Developn system: C – Steppin Text Bo 1. M.	II SY ial equa tability t canonic V DY ion – z- y respon rs for de r PI nent and Control a ag motor oks: . Gopal,	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of rs and their controls: Torque-speed curves, Interfacing of stepper m	analysis of sam as: First compar and lag-lead co as plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position notors to microp <b>Total (4</b> l, New Delhi, 2	pled da nion – S <b>9</b> ompensa lane sy <b>9</b> igital te /speed, process <b>5L + 0</b> .009.	<b>0</b> ator d nthesi <b>0</b> mpera contr ors <b>T</b> ) =	0 esign s – D ature c ol algo	9 using igita 9 ontro prithu
UNIT II Differenti –Jury's st – Jordan d UNIT IV Introducti frequency controller UNIT V Developn system: C – Steppin Text Bo 1. M.	II SY ial equa tability t canonic V DY ion – z- y respon rs for de rs for de PI nent and Control a ag motor oks: . Gopal, . Nagrat	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of rs and their controls: Torque-speed curves, Interfacing of stepper m , "Digital Control and Static Variable Methods", Tata McGraw Hill, th and M. Gopal, "Control Systems Engineering", New Age Interna	analysis of sam as: First compar and lag-lead co as plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position notors to microp <b>Total (4</b> l, New Delhi, 2	pled da nion – S <b>9</b> ompensa lane sy <b>9</b> igital te /speed, process <b>5L + 0</b> .009.	<b>0</b> ator d nthesi <b>0</b> mpera contr ors <b>T</b> ) =	0 esign s – D ature c ol algo	9 using igita 9 ontro prithr
UNIT II Differenti –Jury's st – Jordan of UNIT IV Introducti frequency controller UNIT V Developm system: C – Steppin Text Boo 1. M. 2. I.J. Reference	II     SY       ial equa       ial equa       tability t       canonic       V     D       ion – z-       y responsion       rs for de       rs for de       r Pl       ment and       Control a       ag motor       oks:       . Nagrat       ce Boo	YSTEM tion description – Z-transform method of description– Z-transform a test – Routh stability criterion on the r-plane – State variable concepts cal models – Discrete state variable models – Elementary principles. ESIGN OF DIGITAL CONTROL ALGORITHMS -plane specifications of control system design –Digital lead, lag a nse plots - Digital lead lag compensator design using Root locu eadbeat performance - Examples. RACTICAL ASPECTS OF DIGITAL CONTROL ALGO d implementation of digital PID control algorithms – Tunable PID c algorithm – Digital position control system: Digital measurement of rs and their controls: Torque-speed curves, Interfacing of stepper m , "Digital Control and Static Variable Methods", Tata McGraw Hill, th and M. Gopal, "Control Systems Engineering", New Age Interna	analysis of sam as: First compar- and lag-lead co as plots – z-pl <b>DRITHMS</b> controllers - Di f shaft position totors to microp <b>Total (4</b> l, New Delhi, 2 ational Publishe	pled da nion – S <b>9</b> ompensa lane sy <b>9</b> igital te /speed, process <b>5L + 0</b> .009.	<b>0</b> ator d nthesi <b>0</b> mpera contr ors <b>T</b> ) =	0 esign s – D ature c ol algo	9 using igita 9 ontro prithr

3.	Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2nd Edition, 1996.					
E-R	E-References:					
1.	https://nptel.ac.in/courses/108103008/					
2.	https://www.sciencedirect.com/topics/engineering/digital-control-system					

Cours	se (	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Outline sampling techniques to control systems.	L1: Remembering
CO2	:	Design the various digital control algorithms.	L4: Analyzing
CO3	:	Predict the performance of various types of digital controllers.	L4: Analyzing
CO4	:	Identify the various types of digital compensators.	L2: Understanding
CO5	:	Illustrate applications of digital control.	L3: Applying

23PTEEE13 DIGITAL CONTROLLER IN POWER ELECTRONICS			SEM	FD	VI	
23FIEEE	APPLICATIONS		SEN	ESI	LN	V I
PREREQU	ISITES	CATEGORY	PE	Cre	edit	3
Control Sv	ems, Power Electronics	Hours / Week	L	Т	Р	TH
		Hours, week	3	0	0	3
Course Ob	ectives:					
1. To ur	erstand the concepts of discrete time systems.					
	lyze systems in z domain.					
3. To de	ign the digital controllers					
				0	•	•
UNIT I	INTRODUCTION		9	0	0	9
	Comparison between analog and digital control-Importance of c	•		-		
-	ligital control system-Difference equations-Z-transform-MATLAI Properties of frequency response of discrete time systems-Samplir		ncy resp	onse	of di	screte
time system	Properties of frequency response of discrete time systems-samplin	ig meorem.				
	Z-PLANE ANALYSIS OF DISCRETE-TIME	CONTROL				
UNIT II	SYSTEMS		9	0	0	9
Impulse sam	ling and data hold -Pulse transfer function - Realization of digital	controllers- Mappin	g betwe	een s-	plane	and
z plane - Sta	ility analysis of closed loop systems in z-plane-Transient and stead	ly state analyses.				
			r		r	
UNIT III	STATE SPACE APPROACH TO DISCRETE-TIME CO	ONTROL	9	0	0	9
	SYSTEMS		-			-
-	presentation of continuous and digital control systems - Solution		liscrete	time	state	space
equations -P	lse transfer function matrix - Discretization of continuous time stat	e space equations.				
UNIT IV	DIGITAL CONTROLLER DESIGN METHODS		9	0	0	9
	pensators using Root Locus- Design of PID controllers by using	hilinear transforms	-		v	-
	bilinear transformation- Dead-beat response design- Deadbea			-		
-	variable-Choice of sample time for deadbeat controller-Realization				-	
simulation.	r	6		-		
UNIT V	DIGITAL CONTROLLERS IN POWER ELECTRO	NICS	9	0	0	9
	APPLICATIONS		,	U	U	,
	llers and Digital Signal Controllers for Converter Control Application					
-	re, Compare and PWM, Analog Comparators for instantaneous ov	er current detection	, interru	ipts, 1	Discr	ete PI
and PID equ						
	tions, Algorithm for PI and PID implementation, Example Code for	r PWM generation.				
	tions, Algorithm for PI and PID implementation, Example Code for				<u> </u>	• 1
	tions, Algorithm for PI and PID implementation, Example Code for	r PWM generation. Total (45		) = 4	5 Pe	riods
Taxt Book				) = 4	5 Pe	riods
Text Book		Total (45)	L + <b>0</b> T	) = 4	5 Pe	riods
1. M. Go	al, "Digital Control and State Variable Methods ", McGraw Hill Ec	Total (45)	L + <b>0</b> T	) = 4	5 Pe	riods
1. M. Go 2. K. Oga	al, "Digital Control and State Variable Methods", McGraw Hill Ec a, "Discrete- Time control systems", Pearson Education, India, 2nd	<b>Total (45</b> ) lucation, 4 <sup>th</sup> Edition l Edition, 2015.	L + <b>0</b> T	) = 4	5 Pe	riods
1.         M. Go           2.         K. Oga           3.         B.C. K           Karl J	al, "Digital Control and State Variable Methods", McGraw Hill Ec a, "Discrete- Time control systems", Pearson Education, India, 2nd o, "Digital Control System", Oxford University Press; 2ndEdition	Total (45) lucation, 4 <sup>th</sup> Edition l Edition, 2015. 2012.	L + <b>0T</b> , 2014.			
1.         M. Go           2.         K. Oga           3.         B.C. K           4         Karl J	al, "Digital Control and State Variable Methods", McGraw Hill Ec a, "Discrete- Time control systems", Pearson Education, India, 2nd	Total (45) lucation, 4 <sup>th</sup> Edition l Edition, 2015. 2012.	L + <b>0T</b> , 2014.			

Ref	erence Books:
1.	G.F. Franklin, J. David Powell and M. Workman, Digital Control of Dynamic Systems, 3rd ed., Addison Wesley, 2000.
2.	Constantine H. Houpis and Gary B. Lamont, "Digital Control Systems: Theory, Hardware, Software", McGraw-Hill
۷.	Book Company, 1985.
3.	M. J. Robert, "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
E-R	eference:
1.	https://nptel.ac.in/courses/108103008
Coι	Irse Outcomes: Bloom's Taxonomy
I Im	n completion of this course, the students will be able to:

Cours		Bloom's laxonomy	
Upon	comp	Mapped	
CO1	:	To understand the digital control system	L2: Understanding
CO2	:	Capable of determining the stability in z domain	L1: Applying
CO3	:	To understand the state space analysis	L1: Remembering
CO4	:	To design the various types of digital controllers	L3: Analysing
CO5	:	To check the digital controllers in power electronics design	L5: Evaluating

PRER	CEE14	<b>ROBOTICS AND AUTOMATIC</b>			<b>IEST</b>		V
	EQUIS	TES	CATEGORY	PE	Cr	edit	3
Signals	and Syst	eme	Hours / Week	L	Т	Р	T
Jigitats	and Syst		Hours / Week	3	0	0	3
Cours	e Object	ives:					
l. T	'o underst	and the basic concepts associated with the design, function	ning, applications, and	social a	spects	of rot	oots
2. T	'o study a	pout the electrical drive systems and sensors used in roboti	ics for various applicat	ions.			
		out analyzing robot kinematics, dynamics through different	t methodologies and stu	ıdy vari	ous de	esign as	spec
0		m manipulator and end-effector					
		out various motion planning techniques and the associated					
5. T	o underst	and the implications of AI and other trending concepts of a	robotics.				
UNIT	I BU	ILDING BLOCKS OF A ROBOT		9	0	0	
		s - Geometric approach for 2R, 3R manipulators, homog	enous transformation u		•	-	
		MR, Lagrangian formulation for 2R robot dynamics.		U	1		
UNIT		NEMATICS AND DYNAMICS		9	0	0	
		s - Geometric approach for 2R, 3R manipulators, homog	enous transformation u	using D	-H rep	present	tatio
cinema	tics of W	MR, Lagrangian formulation for 2R robot dynamics.					
				•		0	<u> </u>
UNIT		SIGN OF ROBOTS & END-EFFECTORS		9	0		
		gn aspects of a 2R manipulator, WMR; End-effector - con	nmon types – selectior	n of the	right e	end eff	ect
	ector con	trol, Maintenance, Uses and Benefits.					
	N A	VIGATION PATH PLANNING AN	D CONTROL				1
UNIT		VIGATION, PATH PLANNING AN CHITECTURE	D CONTROL	9	0	0	9
	IV AF	CHITECTURE		-	-	•	
Mappin	IV AF	CHITECTURE gation – SLAM, Path planning for serial manipulators; ty	pes of control archited	ctures -	Cartes	sian co	ontr
Mappin Force c	IV AF	CHITECTURE	pes of control archited ol, application of Neu	ctures -	Cartes	sian co	ontr
Mappin Force c optimiz	ag & Nav control ar cation algo	<b>CHITECTURE</b> igation – SLAM, Path planning for serial manipulators; ty d hybrid position/force control, Behaviour based contro prithms for navigation problems, programming methodolog	pes of control archited ol, application of Neu	ctures - ral netv	Cartes vork, 1	sian co fuzzy	ontr
Mappin Force c optimiz	IV     AF       ag & Nav     Ar       control ar     ar       cation algo     AF       V     RF	CHITECTURE gation – SLAM, Path planning for serial manipulators; ty d hybrid position/force control, Behaviour based control prithms for navigation problems, programming methodolog CENT SEARCH TRENDS IN ROBOTICS	pes of control archited ol, application of Neu gies of a robot.	ctures - ral netv	Cartes vork, 1	sian co fuzzy	ontr log
Mappin Force c optimiz UNIT Applica	IV     AF       ng & Nav     As       ng & Nav     as       control ar     as       cation algo     AF       V     RF       ation of M	CHITECTURE gation – SLAM, Path planning for serial manipulators; ty d hybrid position/force control, Behaviour based control prithms for navigation problems, programming methodolog CENT SEARCH TRENDS IN ROBOTICS Iachine learning - AI, Expert systems; Tele-robotics and V	pes of control archited ol, application of Neu gies of a robot.	ctures - ral netv	Cartes vork, 1	sian co fuzzy	ontr log
Mappin Force c optimiz UNIT Applica	IV     AF       ng & Nav     As       ng & Nav     as       control ar     as       cation algo     AF       V     RF       ation of M	CHITECTURE gation – SLAM, Path planning for serial manipulators; ty d hybrid position/force control, Behaviour based control prithms for navigation problems, programming methodolog CENT SEARCH TRENDS IN ROBOTICS	pes of control archited ol, application of Neu gies of a robot.	ctures - ral netv	Cartes vork, 1	sian co fuzzy	ontr log
Mappin Force c optimiz UNIT Applica	IV     AF       ng & Nav     As       ng & Nav     as       control ar     as       cation algo     AF       V     RE       ation of M	CHITECTURE gation – SLAM, Path planning for serial manipulators; ty d hybrid position/force control, Behaviour based control prithms for navigation problems, programming methodolog CENT SEARCH TRENDS IN ROBOTICS Iachine learning - AI, Expert systems; Tele-robotics and V	vpes of control archited ol, application of Neu gies of a robot. Virtual Reality, Micro	ctures - ral netv 9 &Nanor	Cartes vork, 1 0 robots,	fuzzy <b>0</b> , Unm	ontro log:
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Cours	e O	utcomes:	Bloom's Taxonomy
Upon c	omp	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the basic building blocks of robot.	L2: Understanding
CO2	:	Understand the Design concepts in robotics.	L2: Understanding
CO3	:	Analyze the AI trends in robotics.	L4: Analysing
CO4	:	Apply the algorithms in control architecture.	L3: Applying
CO5	:	Analyze the mathematical solutions for robot dynamics.	L4: Analysing

	INDUSTRIAL AUTOMATION AND CONTROL	SEN	1EST	ER	V
PREREQUISI	TES CATEGORY	PE	Cre	edit	3
Control System	Hours / Week	L	Т	Р	TI
	Hours / Week	3	0	0	3
Course Object	ives:				
	on design of signal conditioning circuits for various applications				
	on signal transmission techniques and their design				
	mponents used in data acquisition systems interface techniques				
	on the components used in distributed control systems				
5. To introdu	the communication buses namely field bus and profibus.				
UNIT I D	ESIGN OF SIGNAL CONDITIONING AND TRANSMISSION	9	0	0	9
unction Compe ransmissions-Di Cemperature Tra	asurement, Level Measurement –Temperature measurement: Thermocouple, RT asation and Linearization – software and Hardware approaches - Electrical, Pr gital transmission protocols-Study of two wire and four wire transmitters – asmitter, Thermocouple based Temperature Transmitter, Capacitance based Leve	neumati Desig	ic and n of 1	fiber RTD	opt base
Flow Transmitter	s-smart sensors.				
UNIT II D	ATA ACQUISITION AND INSTRUMENT INTERFACE	9	0	0	
	l simulation of Building block of instrument Automation system – Signal analysi	-	Ŷ	-	-
	bus protocols - ADC, DAC, DIO, counters & timers, PC hardware structure, t				
	lware installation, current loop, RS 232/RS485, GPIB, USB protocols.	U,		1 '	
	LC AND SCADA	9	0	0	-
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Evolution of PL/Ladder logic – Fill         Ladder logic – Fill         of liquid level sy         Communication         UNIT IV       D         Evolution - Difference         considered in sel         UNIT V       C         Introduction- Evolution       Evolution - Difference         Basic requirement       Introduction, Protection, Prote	C – Sequential and Programmable controllers – Architecture – Programming of inctional blocks – Communication Networks for PLC. PLC based control of proce- stem – heat exchanger – Smart sensors and Field bus. SCADA: - Remote termi- irchitectures and Open SCADA protocols.           ISTRIBUTED CONTROL SYSTEM           rent architectures - Local control unit - Operator Interface – Displays -Engineerin ecting DCS.           OMMUNICATION PROTOCOLS           blution of signal standard – HART communication protocol –Communication mo s –HART and OSI models-HART applications Field bus:- Introduction, Genera nts of Field bus standard, Field bus topology, Interoperability and Intercl fibus protocol stack, Profibus communication model, Communication objects – Foundation fieldbus versus Profibus.           Total (42           rris, "Measurement and Instrumentation Principles", Elsevier, 2006. ond, P.A.Wilson, and M.R.Lepla, "Advanced Control System Technology", Viv	PLC - esses – nal uni g interf g interf des – H al Field nange s, Syste	- Rela Comp ts, Ma 0 Cace- F 0 IART bus a ability em op T = 4	y logi uter c ster st 0 actors 0 Netwo rchite Prof eration	c an ontr atio s to l s to l orks ctur ibus n ar <b>rioc</b>

Course Upon c		Bloom's Taxonomy Mapped	
CO1	:	Design of signal conditioning circuits for various applications is educated to students.	L3: Applying
CO2	:	Familiar with signal transmission techniques and their design	L3: Applying
CO3	:	Use the components in data acquisition systems, interface techniques	L3: Applying
CO4	:	Familiar on the components used in distributed control systems	L2: Understanding
CO5	:	Familiar on communication buses namely field bus and profibus	L2: Understanding

	HVDC TRANSMISSION SYSTEMS		SEN	<b>IEST</b>	ER	VI
PREREQUIS	TES	CATEGORY	PE	Cre	edit	3
Power System G	eneration, Transmission and Distribution Systems	Hours / Week	L 3	Т 0	P 0	TH 3
Course Objecti	765*		5	U	U	3
	tand the concept, planning of DC power transmission and comp	parison with AC po	wer tra	nsmis	sion.	
	e the converters used in HVDC system.					
-	bout the HVDC system control.					
	tand the reactive power requirements of the converter and Stati	c VAR control met	hods.			
	tand the harmonics generation in HVDC system and design of l					
	knowledge on modelling and analysis of HVDC systems.					
••• ••• ••• ••• ••• ••• ••• ••• ••• ••						
UNIT I	DEVELOPMENT OF HVDC TECHNOLOGY		9	0	0	9
	omparison of AC and DC transmission – Applications of DC tr	ansmission – HVD	-		nfiour	-
	– Planning for HVDC transmission – Modern trends in HV		•		0	
-	C transmission based on voltage source converter - MTDC Sy	•••			opt	iumg
		stenn: types and upp	Jiicutio	110		
UNIT II	ANALYSIS OF HVDC CONVERTERS		9	0	0	9
	d converter - Pulse number – Choice of best topology for HVE	C - Analysis of si	-			-
	and with overlap less than $60^{\circ}$ - Equivalent circuit model - Co	•	-		-	
-	ers - Analysis of Capacitor Commutated Converter (CCC) - An	-			-	
12 puise convert	ers - Anarysis of Capacitor Commutated Converter (CCC) - An		ullvi		nveru	<b>1</b> .
UNIT III	CONTROL OF HVDC SYSTEMS		9	0	0	9
		Control Hieronaha		v	v	
	of DC link control – Converter control characteristics – System	•			-	
	nction angle control – Starting and stopping of DC link and based HVDC link.	power control – H	igner i	ever	contro	liers –
Control of VSC	based H v DC IIIK.					
UNIT IV	REACTIVE POWER CONTROL, HARMONICS A	ND FILTERS	9	0	0	9
Reactive power	requirements in steady state – Sources of reactive power – SVC	and STATCOM.				
Generation of H						
	rmonics: characteristic and non-characteristics harmonics – Tre	oubles caused by ha	armoni	cs - D	esign	of AC
filters – Design	armonics: characteristic and non-characteristics harmonics – Transford DC Filters – Active filters.	oubles caused by ha	armoni	cs - D	esign	of AC
filters – Design o		oubles caused by ha	armoni	cs - D	esign	of AC
			armoni 9	cs - D	esign 0	of AC
UNIT V	of DC Filters –Active filters.	MS	9	0	0	9
UNIT V System models:	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net	MS works; System sim	<b>9</b> nulation	<b>0</b> 1: Phil	0 losoph	<b>9</b> y and
UNIT V System models: tools – Physical	of DC Filters – Active filters. MODELLING AND ANALYSIS OF HVDC SYSTE	MS works; System sim	<b>9</b> nulation	<b>0</b> 1: Phil	0 losoph	<b>9</b> y and
UNIT V System models: tools – Physical	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I	MS works; System sim	<b>9</b> nulation	<b>0</b> 1: Phil	0 losoph	<b>9</b> y and
UNIT V System models: tools – Physical	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I	MS works; System sim	<b>9</b> ulation ital dyr	0 n: Phil namic	0 losoph simula	9 y and ation -
UNIT V System models: tools – Physical	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I	MS works; System sim DC systems for digi	<b>9</b> ulation ital dyr	0 n: Phil namic	0 losoph simula	9 y and ation -
UNIT V System models: tools – Physical Transient simula Text Books:	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I	MS works; System sim DC systems for digi Total (	9 aulation atal dyr 45L +	0 n: Phil namic 0T) =	0 losoph simula	9 ation - eriods
UNIT V System models: tools – Physical Transient simula Text Books: 1. K.R. Padi 2015.	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I tion of DC and AC networks. yar, "HVDC Power Transmission Systems", New Age Internat	MS works; System sim DC systems for digi Total ( ional Publishers, N	9 ulation ital dyr 45L + ew De	0 n: Phil namic 0T) =	0 losoph simula	9 ation - eriods
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UNIT V System models: tools – Physical Transient simula Text Books: 1. K.R. Padi 2015. 2. Edward V Reference Book 1. Colin Ad	of DC Filters –Active filters. MODELLING AND ANALYSIS OF HVDC SYSTEN converter – converter controllers – DC networks and AC net model (HVDC simulator) and Parity simulator – Modelling of I tion of DC and AC networks. yar, "HVDC Power Transmission Systems", New Age Internat /ilson Kimbark, "Direct Current Transmission", Vol. I, Wiley I s: amson and N.G. Hingorani, "High Voltage Direct Current	MS works; System sim DC systems for digi Total ( ional Publishers, N nterscience, New Y	9 ulation ital dyr 45L + ew De	0 n: Phil namic 0T) = lhi, Th 971.	0 losoph simula <b>45 P</b> e	9 ation - eriods
UNIT V System models: tools – Physical Transient simula Text Books: 1. K.R. Padi 2015. 2. Edward V Reference Book 1. Colin Ad London, H	of DC Filters –Active filters. <b>MODELLING AND ANALYSIS OF HVDC SYSTE</b> converter – converter controllers – DC networks and AC net nodel (HVDC simulator) and Parity simulator – Modelling of I tion of DC and AC networks. yar, "HVDC Power Transmission Systems", New Age Internat /ilson Kimbark, "Direct Current Transmission", Vol. I, Wiley I s:	MS works; System sim DC systems for digi Total ( ional Publishers, N nterscience, New Y	9 ulation ital dyr 45L + ew De	0 n: Phil namic 0T) = lhi, Th 971.	0 losoph simula <b>45 P</b> e	9 ation - eriods

3	Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.
4	S. Kamakshaiah and V. Kamaraju, "HVDC Transmission", First Edition, Tata McGraw Hill, 2011.
E-Re	ference:
1.	www.onlinecourses.nptel.ac.in/noc18_ee41

Cours	se O	Bloom's Taxonomy	
Upon	con	Mapped	
CO1	:	Outline the concept of HVDC technology and MTDC systems.	L2: Understanding
CO2	:	Analyze the converters used in HVDC system	L4: Analyzing
CO3	:	Acquire knowledge about basic principles of HVDC system control	L2: Understanding
CO4	:	Design of static VAR systems for reactive power control and filters for harmonic mitigation in HVDC system.	L3: Applying
CO5	:	Develop the modelling and Analysis of HVDC systems.	L4: Analyzing

Power Generation, Iransmission and Distribution System       Hours / Week       3       0       0       3         Course Objectives:       1.       To emphasize the fundamental concept of EHVAC transmission, electrostatic effects, corona effects and voltage controller for an EHVAC transmission system       9       0       0       9         UNIT I       INTRODUCTION       9       0       0       9       0       0       9         Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.       9       0       0       9         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Ines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electrostatic field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9 <td< th=""><th><b>23PTEEE22</b></th><th>EHVAC TRANSMISSION SYSTEM</th><th>IS</th><th>SEM</th><th>IEST</th><th>ER</th><th>VI</th></td<>	<b>23PTEEE22</b>	EHVAC TRANSMISSION SYSTEM	IS	SEM	IEST	ER	VI
Power Generation, Transmission and Distribution System       Hours / Week       3       0       0       3         Course Objectives:       To emphasize the fundamental concept of EHVAC transmission, electrostatic effects, corona effects and voltage controller for an EHVAC transmission system       9       0       0       9         UNIT I       INTRODUCTION       9       0       0       9       0       0       9         Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.       9       0       0       9       0       0       9         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       0       9       0 <t< th=""><th>PREREQUIS</th><th>ITES</th><th>CATEGORY</th><th>PE</th><th>Cr</th><th>edit</th><th>3</th></t<>	PREREQUIS	ITES	CATEGORY	PE	Cr	edit	3
Course Objectives:       3       0       0       3         1.       To emphasize the fundamental concept of EHVAC transmission, electrostatic effects, corona effects and voltage controller for an EHVAC transmission system         UNIT I       INTRODUCTION       9       0       0       9         Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.       9       0       0       9         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT II       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.       9       0       0       9         UNIT IV       CORONA EFFECTS       9       0       0       9       0       0       9	Derman Company	The minimum in the Distribution Contains		L	Т	Р	TH
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1.       controller for an EHVAC transmission system         UNIT I       INTRODUCTION       9       0       0       9         Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors fusces voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.       9       0       0       9         UNIT IV       CORONA EFFECTS       9       0       0       9       0       0       9         Power loss and corona loss, charge-voltage (q-V) diagram and corona loss, attenuation of travelling waves due to corona audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, re	Course Objec	tives:	·				
controller for an EHVAC transmission system         UNIT I       INTRODUCTION       9       0       0       9         Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       9       0       0       0       9       0       0       0       9       0       0       0       9       0       0       0       9       0       0       0       9	1 To empha	size the fundamental concept of EHVAC transmission, elect	rostatic effects, cord	ona eff	ects a	and v	oltage
Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.       9       0       0       9         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q-V) diagram and corona loss, attenuation of travelling waves due to corona audible noise egeneration and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and	<sup>1</sup> . controller	for an EHVAC transmission system					
Necessity of EHV AC transmission, benefits and challenges, power handling capacity and line losses, mechanical considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.       9       0       0       9         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q-V) diagram and corona loss, attenuation of travelling waves due to corona audible noise egeneration and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and							
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considerations, resistance of conductors, temperature rise of conductors and current-carrying capacity, properties of bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona uoss, and the asign, relation between single-phase and three-phase AN levels example       9       0       0       9         Power loss and its use in design, relation between single-phase and three-phase AN levels example       Total (45L + 0T) = 45 Periods         Total (45L + 0T) = 45 Periods       Total (45L + 0T) = 45 Periods         I       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.       2011	Necessity of E	HV AC transmission, benefits and challenges, power hand	ling capacity and 1	ine los	ses,	mech	anical
bundled conductors – numerical problems.         UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.       9       0       0       9         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power loss and corona us synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system       9       0       0       9         Power icricle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compen	•	· · · ·					
UNIT II       LINE AND GROUND REACTIVE PARAMETERS       9       0       0       9         Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.       9       0       0       9         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona aloss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         1.       R. D. Begamudre, "EHVAC Tr				1		1	
Inductance of EHV line configurations, line capacitance calculation, sequence inductances and capacitances, line parameters for modes of propagation, resistance and inductance of ground return.         UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.		<u>^</u>					
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UNIT III       VOLTAGE GRADIENTS OF CONDUCTORS       9       0       0       9         Electrostatics, field of sphere gap, field of line changes and properties, charge – potential relations for multi-conductors lines, surface voltage gradient on conductors, distribution of voltage gradient on sub-conductors of bundle, effect of high electro static field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:			and the second		,	putu	
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electro static field on humans, animals and plants.         UNIT IV       CORONA EFFECTS       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         Text Books:       1       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.       2.         Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.       Reference Books:       3			-				
UNIT IV       CORONA EFFECTS       9       0       0       9       0       0       9         Power loss and corona loss, charge-voltage (q–V) diagram and corona loss, attenuation of travelling waves due to corona loss, audible noise: generation and characteristics, limits for audible, audible noise measurement and meters, formulae for audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system       Total (45L + 0T) = 45 Periods         Text Books:       1       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.       2.         Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.       Reference Books:					,		0
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audible noise and its use in design, relation between single-phase and three-phase AN levels example         UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         Text Books:         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:	Power loss and	corona loss, charge-voltage (q-V) diagram and corona loss, at	tenuation of travelling	ng wav	es du	e to c	orona
UNIT V       POWER FREQUENCY VOLTAGE CONTROL       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system       9       0       0       9         Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system       Total (45L + 0T) = 45 Periods         Text Books:       1       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:       1	loss, audible no	ise: generation and characteristics, limits for audible, audible r	oise measurement a	nd met	ers, fo	ormul	ae for
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Power circle diagram and its use - voltage control using synchronous condensers - cascade connection of shunt and series compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system <b>Total (45L + 0T) = 45 Periods</b> <b>Text Books:</b> 1. R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011. 2. Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023. <b>Reference Books:</b>							
compensation - sub synchronous resonance in series capacitor - compensated lines - static VAR compensating system         Total (45L + 0T) = 45 Periods         Text Books:         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:	UNIT V	POWER FREQUENCY VOLTAGE CONTROL		9	0	0	9
Text Books:       Total (45L + 0T) = 45 Periods         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:	Power circle dia	gram and its use - voltage control using synchronous condens	ers - cascade connec	tion of	shun	t and	series
Text Books:         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:	compensation -	sub synchronous resonance in series capacitor - compensated l	ines - static VAR con	npensa	ting s	systen	ı
Text Books:         1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:							
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1.       R. D. Begamudre, "EHVAC Transmission Engineering" New Age International (P)Ltd., Fourth Edition, 2011.         2.       Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.         Reference Books:			Total (45)	L + 07	<b>(</b> ) = 4	15 Pe	riods
<ol> <li>Sunil. S. Rao, "HVAC and DC Transmission practice", Khanna Publishers, Delhi, 2023.</li> <li>Reference Books:</li> </ol>	Text Books:		Total (45)	L + 07	<b>(</b> ) = 4	15 Pe	riods
Reference Books:		gamudre, "EHVAC Transmission Engineering" New Age Inter	×		,		
	1. R. D. Beg		national (P)Ltd., Fou		,		
	1.         R. D. Beg           2.         Sunil. S.	Rao, "HVAC and DC Transmission practice", Khanna Publish	national (P)Ltd., Fou		,		

Cours	se (	Dutcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1		Summarize the trends in EHVAC Transmission and calculate Line inductance and	L2: Understanding
COI	•	capacitances of bundled conductors.	L2. Onderstanding
CO2	:	Analyze the transmission line parameters.	L4: Analysing
CO3	:	Recall the electrostatic effects and corona effects.	L1: Remembering
CO4	:	Select the appropriate voltage control devices.	L4: Analysing
CO5	:	Apply the compensation techniques.	L3: Applying

23P	TEEE	23 FLEXIBLE AC TRANSMISSION SYST	EMS	SEM	EST	ER	VI
PRE	REQU	ISITES	CATEGORY	PE	Cr	edit	3
Powe	er Gener	ation, Transmission and Distribution System	Hours / Week	L	Т	P	TH
1000	I Ocher	aton, maismission and Distribution System	Hours / Week	3	0	0	3
Cou	rse Ob	jectives:					
1.	To int	roduce the reactive power control techniques.					
2.	To edu	acate on static VAr compensators and their applications					
3.	To pro	wide knowledge on thyristor-controlled series capacitors					
4.		dy about STATCOM devices					
5.	To acc	uire knowledge on FACTS controllers					
				T			
UNI		INTRODUCTION		9	0	0	9
		ver Control in Electrical Power Transmission Lines -Uncompensated					
		epts of Static Var Compensator (SVC) – Thyristor Controlled Serie	es Capacitor (TCSC	) – Uni	fied I	Power	Flow
Cont	roller (U	PFC).					
UNI	тп	STATIC VAD COMDENSATOD (SVC) AND ADDI IC	ATIONS	9	0	0	9
		STATIC VAR COMPENSATOR (SVC) AND APPLICA rol by SVC – Advantages of Slope in Dynamic Characteristics – Inf		-	-	-	
	0	age Regulator – Modelling of SVC for Power Flow and Fast Transi					U
		Stability – Steady State Power Transfer – Enhancement of Power S	• • •	ncatioi	18. EI	mane	ement
01 11	ansient	Stability – Steady State Fower Transfer – Elinancement of Fower S	ystem Damping.				
		THYRISTOR CONTROLLED SERIES CAPACITOR	(TCSC) AND				
UNI	T III	APPLICATIONS	(1050) 11(2	9	0	0	9
Opera	ation of	the TCSC – Different Modes of Operation – Modelling of TCSC –	Variable Reactance	Model	- Mo	odelli	ng for
Powe	er Flow	and Stability Studies. Applications: Improvement of the System	Stability Limit – E	nhance	ment	of S	ystem
Dam	ping						
				1	1	1	
UNI	T IV	VOLTAGE SOURCE CONVERTER BASED FACTS		9	0	0	9
		CONTROLLERS		-			
		- Principle of Operation - V-I Characteristics. Applications: Stea	•				
		bility – Prevention of Voltage Instability. SSSC-Operation of SSSC	and the Control of I	Power I	-low -	-Mod	elling
of SS	SC In L	oad Flow and Transient Stability Studies.					
UNI	ти	<b>CO-ORDINATION OF FACTS CONTROLLERS</b>		9	0	0	9
		teractions – SVC – SVC Interaction – Co-ordination of Multiple Co	ontrollers using Lin	-		v	
		ordination using Genetic Algorithm.	Shuohers using Lin		nuoi	rcem	iiques
			Total (45)	<b>T0</b> + .]	() - 4	15 Pe	rinds
-			10001 (42)		) = 1		nous
Text	Books	:					
1.	R.Moha	n Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers Fo	or Electrical Transn	nission	Syste	ems",	IEEE
		nd John Wiley & Sons, Inc, 2002.					
		G. Hingorani, "Understanding FACTS -Concepts and Technolog	y of Flexible AC 7	ransmi	ission	Syst	ems",
		d Publishers Distributors, Delhi- 110 006, 2011.					
1		liyar, "FACTS Controllers in Power Transmission and Distributio	n", New Age Intern	ational	Publ	ishers	s New
	Delhi, s	econd edition, 2016					

Ref	erence Books:
1.	A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2.	V.K.Sood, "HVDC And FACTS Controllers – Applications of Static Converters in Power System", Kluwer Academic
2.	Publishers, 2004.
3.	Xiao - Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control"
5.	Springer, 2012.
E-R	References:
1.	www.onlinecourses.nptel.ac.in
2.	www.class-central.com
3.	www.mooc-list.com

Cours	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Identify suitable compensator for reactive power compensation.	L3: Applying
CO2	:	Analyse the impacts in network operations due to SVC placement.	L4: Analyzing
CO3	:	Visualise the significance of TCSC in network operation.	L3: Applying
CO4	:	Evaluate the performance of steady state and transients of FACTS controllers.	L5: Evaluating
CO5	:	Elaborate the features of coordination of FACTS controllers.	L3: Applying

23P'	TEEE	24 SUBSTATION ENGINEERING AND AUTOMAT	ION	SEN	1EST	ER	VI
PRE	REQU	JISITES CA	TEGORY	PE	Cr	edit	3
Elect	rical M	easurements; Power Generation, Transmission and Distribution	urs / Week	L	Т	P	TH
syste	m	Hot	urs / week	3	0	0	3
Cou	rse Ob	jectives:					
1.	To ur	derstand the importance of the substation design					
2.		tline the different factor for effecting substation design					
3.		assify the bus configurations					
4.		ow the design criteria for substation grounding					
5.	To ur	derstand the importance of substation automation					
UNI	тт	INTRODUCTION		9	0	0	9
		Need Determination, Budgeting, Financing, Traditional and innovative	Substation De	-	-	-	
		Design, Construction and Commissioning Process	Substation De	Sign, c	Site St	liceth	
11040							
UNI	TII	HIGH VOLTAGE SWITCHING EQUIPMENT		9	0	0	9
Amb	ient co	nditions, Disconnect switches, Load Break switches, high speed groun	nding switche	s, pov	ver fu	ises,	circuit
switc	hes, cir	cuit breakers.					
UNI	T III	TYPES OF SUBSTATIONS & BUS/SW CONFIGURATIONS	ITCHING	9	0	0	9
Trans	smissio	n substation, distribution substation, collector substation, switching subs	stations, gas ir	sulate	d sub	statio	ns, air
		ostations, bus configurations: single bus, double bus, double break, mair	-				
break	ker, ring	bus, break-and-a-half, Comparison of configurations.					
	T IV	DESIGN OF SUBSTATION GROUNDING AND PROTECT		9	0	0	9
		substation grounding system, accidental ground circuit, Design criteria			-	-	
		rid resistance, grid current, use of the design equations, selection of cond ns. Lightning stroke protection-lightning parameters, empirical design me					
		protection measures, fire protection selection criterion.	emous. Substa		e pro	lectio	II-PIIC
muzui	us, 1110						
UNI	ΤV	SUBSTATION AUTOMATION AND COMMUNICATIONS		9	0	0	9
Intro	duction	, components of substation automation system, automation applications	s, protocol fun	damer	ntals,	super	visory
		data acquisition (SCADA) historical perspective, SCADA functional re	-				
-		s, components of SCADA system, SCADA communication protocols, the		SCAD	A com	muni	cation
proto	col, sec	urity for substation communications, security methods, security assessme	ent.				
			T-4-1 (45	r . 07		17 D.	
			Total (45)	L + U.	() = 4	15 Pe	rioas
Toy	Book	7.					
		. McDonald, "Electrical Power Substation Engineering", CRC Press, 3 <sup>rd</sup>	Edition 2017				
I		Books:	Luition, 2017.				
		Dahiya and Vinay Attri, "Sub-Station Engineering Design & Compute	r Applications	<u>," S</u> 1	K Kat	aria	and son
		ations, 1 st Edition, 2013.	- rpriouton	.,	- 150		
		atnam and P. V. Gupta, "Substation Design and Equipment", Dhanapat R	ai Publication	s, 1 <sup>st</sup> E	ditior	, 201	3.
3.		Gonen, "Electric Power Distribution Engineering", CRC Press, Third Edi					

E-R	References:
1.	https://www.transgrid.com.au/what-we-do/our-network/connections
2.	https://new.abb.com/substations
3.	https://ieeexplore.ieee.org/document/178016
4.	https://www.sciencedirect.com/topics/engineering/substations

Taxonomy

ſ	Course O	outo	comes:	Bloom's Taxono
	Upon comp	plet	ion of this course, the students will be able to:	Mapped
	CO1	:	Understand the commissioning of substation	L2: Understanding
	CO2	:	Know working principles of substation switching equipment	L2: Understanding
	CO3	:	Identify the different types of bus configurations	L1: Remembering
	CO4	:	Design substation grounding and protection	L6: Creating
	CO5	:	Analyse the substation communication (SCADA)	L4: Analysing

	POWER SYSTEM AUTOMATION		SEN	1EST	ER	VI
PREREQUIS		CATEGORY	PE	Cre	edit	3
	ion, Transmission and Distribution System; Power System	Hours / Week	L	Т	P	TH
Analysis and Sta	·		3	0	0	3
Course Objec	tives:					
	e fundamental knowledge on power system instrumentation.					
	arise on automations in electric power distribution systems.					
3. To get con	nceptual aspects in modern tools for power system automation.					
UNIT I M	IEASUREMENTS AND SIGNAL TRANSMISSION T	ECHNIQUES	9	0	0	9
Object and phil	osophy of power system instrumentation to measure large cur	rents, high voltage	s, Tore	que a	nd Sp	eed
-	cations - Data acquisition systems for Power System applications		on and	Telen	netry -	PL
equipment, RTU	J, IED - computer control of power system - Man Machine Inter-	face.				
						0
	COMMUNICATION TECHNOLOGIES		9	0	0	9
	requirements; Two-way capability – outages and faults; Publicity – outages and faults; Publici	-				
	ication – ripple control, cyclocontrol, carrier frequency (PLC,					
	HF multi address system radio, VHF, PSN, Cellular radio), Fibre	optics, Satellite com	imunic	ation.	Stand	lard
EE802, IEC618	330					
UNIT III D	DISTRIBUTION SYSTEM INSTRUMENTATION		9	0	0	9
	automation switching control – management information system	stome (MIS) ro	-	-	-	
communication		) graphical inform	mation	eveto	me (1	1C)
	method for data transfer – consumer information service (CIS reading $(AMR)$ – Remote control load management	) – graphical inform	nation	syste	ms (C	JIS)
	reading (AMR) – Remote control load management.	) – graphical inform	nation	syste	ms (C	JIS)
automatic meter		) – graphical inform	nation 9	syste	ms (C	
automatic meter	reading (AMR) – Remote control load management.		9	0	0	9
UNIT IV D Introduction to c	reading (AMR) – Remote control load management.	on – Substation auto	<b>9</b> omatio	<b>0</b> n, Sut	<b>0</b> Dsyste	<b>9</b> ms i
automatic meter         UNIT IV       D         Introduction to c         distribution con	reading (AMR) – Remote control load management. DISTRIBUTION AUTOMATION distribution automation: Customer automation- Feeder automation	on – Substation auto ement systems, Di	<b>9</b> omatio	0 n, Sut ion m	0 osyste anage	9 ms i emer
automatic meterUNIT IVDIntroduction to cdistribution consystem framewo	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation trol centre – Distribution management systems-Outage management	on – Substation auto ement systems, Di	<b>9</b> omatio	0 n, Sut ion m	0 osyste anage	9 ms i emer
automatic meter         UNIT IV       D         Introduction to condistribution consystem framewoother systems.	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage management-Advanced real time DMS applications- Advanced analytical I	on – Substation auto ement systems, Di	9 omatio stribut DMS c	0 n, Sub ion m	<b>0</b> osyste aanage natior	<b>9</b> ms i emer n wit
unit in the second system framewo       unit v	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b>	on – Substation auto ement systems, Di DMS applications –	9 omatio stribut DMS c 9	0 n, Sub ion m coordi	0 osyste aanage natior	9 ms i emer n wit
automatic meter       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V       C       Smart system	Preading (AMR) – Remote control load management.           DISTRIBUTION AUTOMATION           distribution automation: Customer automation- Feeder automation           trol centre – Distribution management systems-Outage manage           ork-Advanced real time DMS applications- Advanced analytical D           CONCEPTS FOR SMART SYSTEMS           solutions – Asset optimization, Demand optimization, dist	on – Substation auto ement systems, Di DMS applications – ribution optimizat	9 omatio stribut DMS c 9 ion, si	0 n, Sub ion m coordi 0 mart	0 osyste aanage natior 0 meter	9 ms i emer n wit 9 an
automatic meter       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V       C       Smart system       communications	<ul> <li>reading (AMR) – Remote control load management.</li> <li>DISTRIBUTION AUTOMATION</li> <li>distribution automation: Customer automation- Feeder automation trol centre – Distribution management systems-Outage managerk-Advanced real time DMS applications- Advanced analytical E</li> <li>CONCEPTS FOR SMART SYSTEMS</li> <li>solutions – Asset optimization, Demand optimization, disting, transmission optimization; Demand side management and optimization; Demand si</li></ul>	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response –	9 omatio stribut DMS c 9 ion, si - DSM	0 n, Sub ion m coordi 0 mart 1 Plar	0 osyste aanage natior 0 meter nning-	9 ms i emer n wit 9 . an DSI
UNIT IV     D       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V       C       Smart system       communications       techniques; Adv	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio	9 omatio stribut DMS c 9 ion, si - DSM	0 n, Sub ion m coordi 0 mart 1 Plar	0 osyste aanage natior 0 meter nning-	9 ms i emer n wit 9 . an DSI
UNIT IV     D       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V       C       Smart system       communications       sechniques; Adv	<ul> <li>reading (AMR) – Remote control load management.</li> <li>DISTRIBUTION AUTOMATION</li> <li>distribution automation: Customer automation- Feeder automation trol centre – Distribution management systems-Outage managerk-Advanced real time DMS applications- Advanced analytical E</li> <li>CONCEPTS FOR SMART SYSTEMS</li> <li>solutions – Asset optimization, Demand optimization, disting, transmission optimization; Demand side management and optimization; Demand si</li></ul>	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio	9 omatio stribut DMS c 9 ion, si - DSM	0 n, Sub ion m coordi 0 mart 1 Plar	0 osyste aanage natior 0 meter nning-	9 ms i emer n wit 9 . an DSI
automatic meter       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V       C       Smart system       communications       techniques; Adv	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems.	9 stribut DMS c 9 ion, si - DSM n man	0 n, Sub ion m coordi b mart I Plan ageme	<b>0</b> osyste aanage natior <b>0</b> meter ning- ent sy	9 ms i emer 1 wit 9 . an DSN sten
automatic meter         UNIT IV       D         Introduction to c         distribution con         system framewo         other systems.         UNIT V       C         Smart system         communications         techniques; Adv	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio	9 stribut DMS c 9 ion, si - DSM n man	0 n, Sub ion m coordi b mart I Plan ageme	<b>0</b> osyste aanage natior <b>0</b> meter ning- ent sy	9 ms i emer 1 wit 9 . an DSN sten
automatic meter         UNIT IV       D         Introduction to c         distribution con         system framewo         other systems.         UNIT V       C         Smart system         communications         techniques; Adv	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems.	9 stribut DMS c 9 ion, si - DSM n man	0 n, Sub ion m coordi b mart I Plan ageme	<b>0</b> osyste aanage natior <b>0</b> meter ning- ent sy	9 ms i emer n wit 9 an DSN stem
automatic meter         UNIT IV       D         Introduction to c         distribution con         system framewo         other systems.         UNIT V       C         Smart system         communications         techniques; Adv	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems.	9 stribut DMS c 9 ion, si - DSM n man	0 n, Sub ion m coordi b mart I Plan ageme	<b>0</b> osyste aanage natior <b>0</b> meter ning- ent sy	9 ms i emer n wit 9 an DSN stem
automatic meter         UNIT IV       D         Introduction to c         distribution con         system framewo         other systems.         UNIT V       C         Smart system         communications         techniques; Adva         and outage mana         Text Books:	reading (AMR) – Remote control load management. <b>DISTRIBUTION AUTOMATION</b> distribution automation: Customer automation- Feeder automation         trol centre – Distribution management systems-Outage manage         ork-Advanced real time DMS applications- Advanced analytical D <b>CONCEPTS FOR SMART SYSTEMS</b> solutions – Asset optimization, Demand optimization, dist         s, transmission optimization; Demand side management and optimization automatice	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems. <b>Total (45)</b>	9 stribut DMS c 9 ion, si - DSM n man	0 n, Sub ion m coordi b mart I Plan ageme	<b>0</b> osyste aanage natior <b>0</b> meter ning- ent sy	9 ms i emer i wit 9 an DSN ster
automatic meter       UNIT IV     D       Introduction to c       distribution con       system framewo       other systems.       UNIT V     C       Smart system       communications       techniques; Advand outage mana       Text Books:       1.     A.S. Pable	<ul> <li>reading (AMR) – Remote control load management.</li> <li>DISTRIBUTION AUTOMATION</li> <li>distribution automation: Customer automation- Feeder automation trol centre – Distribution management systems-Outage managerk-Advanced real time DMS applications- Advanced analytical E</li> <li>CONCEPTS FOR SMART SYSTEMS</li> <li>solutions – Asset optimization, Demand optimization, dists, transmission optimization; Demand side management and ovanced metering infrastructure integration with distribution automatical system; Smart homes with home energy management system</li> </ul>	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems. <b>Total (45)</b> 2019.	9 omatio stribut DMS c 9 ion, su - DSM n man	0 n, Subicordi ion micoordi mart 1 Plar ageme T) = 4	0 osyste anage nation 0 meter ning- ent sy 5 Per	9 ms i emer i wit 9 an DSN ster
UNIT IV     D       Introduction to c     distribution con       system framewo     other systems.       UNIT V     C       Smart system     C       Smart system     C       communications     techniques; Advand outage mana       Ind outage mana     Image: Communications       Text Books:     1.       1.     A.S. Pabla       2.     Mini S Th	<ul> <li>reading (AMR) – Remote control load management.</li> <li>DISTRIBUTION AUTOMATION distribution automation: Customer automation- Feeder automation trol centre – Distribution management systems-Outage manage ork-Advanced real time DMS applications- Advanced analytical D CONCEPTS FOR SMART SYSTEMS solutions – Asset optimization, Demand optimization, dist s, transmission optimization; Demand side management and o vanced metering infrastructure integration with distribution auto agement system; Smart homes with home energy management system a, "Electric Power Distribution", Tata McGraw Hill, New Delhi,</li> </ul>	on – Substation auto ement systems, Di DMS applications – ribution optimizat demand response – omation, distributio ystems. <b>Total (451</b> 2019. art Grids", Taylor a	9 omatio stribut: DMS c 9 ion, sı - DSM n man L + 01	0 n, Subion microordi $0$ mart 1 Plar ageme $T) = 4$ ncis, 2	0 osyste anage natior 0 meter ming- ent sy 5 Per 2015.	9 ms i emer n wit 9 an DSN sten

Refe	erence Books:
1.	Momoh A. Momoh and James A. Momoh., "Electric Power Distribution, Automation, Protection, and Control", CRC
	Press, 2007.
2.	Gonen, "Electric Power Distribution System Engineering", BSP Books, Pvt. Ltd, 2007.

Cour	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the conceptual aspects in power system measurements and signal transmission techniques.	L2: Understanding
CO2	:	Demonstrate various communication technologies for data transmission.	L3: Applying
CO3	:	Acquire proficiency to distribution system instrumentation.	L3: Applying
CO4	:	Demonstrate the automation in power distribution system.	L3: Applying
CO5	:	Conceptualize the smart tools for automation.	L3: Applying

PREREQUISITES       CATEGORY         Power Generation, Transmission and Distribution Systems; Power System       Hours / Week         Analysis and Stability       Hours / Week         Course Objectives:       Image: Compart Knowledge on generation of switching transients and their control.         1.       To impart knowledge on generation of switching transients and their control.         2.       To familiarise on the mechanism of lighting strokes and the production of lighting surges.         3.       To understand the propagation, reflection and refraction of travelling waves.         4.       To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.         VNTT I       INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with s double frequency transients - basic transforms of the RLC circuit transients. Different types of power effect of transients on power systems – role of the study of transients in system planning.	9 sine w	T 0	edit P 0	
Analysis and Stability       Hours / Week         Course Objectives:	3 on on i 9 sine w	0 integr	0	3 power
Course Objectives:         1.       To impart knowledge on generation of switching transients and their control.         2.       To familiarise on the mechanism of lighting strokes and the production of lighting surges.         3.       To understand the propagation, reflection and refraction of travelling waves.         4.       To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.         UNIT I       INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	on on i 9 sine w	integr 0	rated 1	oower
1.       To impart knowledge on generation of switching transients and their control.         2.       To familiarise on the mechanism of lighting strokes and the production of lighting surges.         3.       To understand the propagation, reflection and refraction of travelling waves.         4.       To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.         UNIT I         INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	9 sine w	0	-	
<ul> <li>2. To familiarise on the mechanism of lighting strokes and the production of lighting surges.</li> <li>3. To understand the propagation, reflection and refraction of travelling waves.</li> <li>4. To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.</li> <li><b>UNIT I</b> INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with s double frequency transients - basic transforms of the RLC circuit transients. Different types of power     </li> </ul>	9 sine w	0	-	
3.       To understand the propagation, reflection and refraction of travelling waves.         4.       To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.         UNIT I INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	9 sine w	0	-	
4.       To acquire knowledge on voltage transients caused by faults, circuit breaker action, load rejection system.         UNIT I INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	9 sine w	0	-	
system.         UNIT I       INTRODUCTION         Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	9 sine w	0	-	
UNIT I         INTRODUCTION           Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	sine w	-	0	•
Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	sine w	-	0	•
Review and importance of the study of transients - causes for transients. RL circuit transient with st double frequency transients - basic transforms of the RLC circuit transients. Different types of power	sine w	-	0	•
double frequency transients - basic transforms of the RLC circuit transients. Different types of power		vave	1	9
	ver sys			
effect of transients on power systems – role of the study of transients in system planning.		stem	transi	ents -
		-		-
UNIT II SWITCHING TRANSIENTS	9	0	0	9
Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting	-			
- load switching and equivalent circuit - waveforms for transient voltage across the load and the switch -				
switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance			-	
source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple	ole rest	trikin	g tran	sients
- Ferro resonance.				
		T .	<b>T</b> .	1 -
UNIT III LIGHTNING TRANSIENTS	9	0	0	9
Review of the theories in the formation of clouds and charge formation - rate of charging of thunder cl				
lightning discharges and characteristics of lightning strokes - model for lightning stroke - factors con		-	-	d line
design - protection using ground wires - tower footing resistance - Interaction between lightning and p	power	r syste	em.	
		T	1	<u> </u>
UNIT IV TRAVELING WAVES ON TRANSMISSION LINE	9	0	0	9
COMPUTATION OF TRANSIENTS				
Computation of transients - transient response of systems with series and shunt lumped parameters				
Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural freque	encies	s - ref	flectio	n and
refraction of travelling waves.		1		I _
		0	0	9
refraction of travelling waves.         UNIT V       TRANSIENTS IN INTEGRATED POWER SYSTEM	9	1		
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo	oad re	-		-
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated	oad re	-		-
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo	oad re	-		-
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated	oad re	-		-
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated	oad re ted sys	stem	Quali	tative
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrate application of EMTP for transient computation.	oad re ted sys	stem	Quali	tative
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrate application of EMTP for transient computation.	oad re ted sys	stem	Quali	tative
UNIT V         TRANSIENTS IN INTEGRATED POWER SYSTEM           The short line and kilometric fault - distribution of voltages in a power system - Line dropping and lo transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrate application of EMTP for transient computation.           Total (45L - Total)	oad re ted sys + <b>0T</b>	() = 4	Quali	tative riods

2	C.S. Indulkar, D.P. Kothari, and K. Ramalingam, "Power System Transients – A Statistical Approach", PHI Learning
3.	Private Limited, Second Edition, 2010.
Refe	erence Books:
1.	M.S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill, Fifth Edition, 2013.
2.	R.D. Begamudre, "Extra High Voltage AC Transmission Engineering", Wiley Eastern Limited, 1986.
3.	Y. Hase, "Handbook of Power System Engineering", Wiley India, 2012.
4.	J.L. Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and Use", Wiley, 2012.
5.	Akihiro Ametani, "Power System Transient Theory and Applications", CRC press, 2013.

Cour	Course Outcomes:			
Upon	con	pletion of this course, the students will be able to:	Mapped	
CO1	:	Interpret the switching and lightning transients.	L4: Analysing	
CO2	:	Examine the generation of switching transients and their control.	L4: Analysing	
CO3	:	Analyse the mechanism of lightning strokes.	L4: Analysing	
CO4	:	Recognize the importance of propagation, reflection, and refraction of travelling waves.	L1: Understanding	
CO5	:	Review the concept of circuit breaker action, line dropping, and load rejection in an integrated power system.	L1: Understanding	

23P	TEEE32	DISTRIBUTED GENERATION AND MICR	O GRID	SEM	EST	ER	VII
PRF	EREQUIS	ITES	CATEGORY	PE	Cre	edit	3
Pow	er Generatio	on, Transmission and Distribution Systems	Hours / Week	L	Т	P	TH
			Hours / week	3	0	0	3
Cou	rse Object	tives:					
1.	-	nowledge on distributed generation technologies.					
2.		ise on impact on grid integration.					
3.	To understa	and the microgrid operation and control.					
					1		
UNI		INTRODUCTION		9	0	0	9
	-	wer generation: advantages and disadvantages, Energy crises			(NCI	E) res	ources:
revie	ew of Solar l	PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass	s, and tidal sources				
				-		-	
	IT II	DISTRIBUTED GENERATIONS		9	0	0	9
	-	ributed generations, topologies, selection of sources, regula	•				
	-	Distributed resources to electric power systems: IEEE 1547. D			irity i	ssues	in DG
impl	ementations	. Energy storage elements: Batteries, ultra-capacitors, flywhee	Is. Captive power j	plants.			
				0		•	0
		IMPACT OF GRID INTEGRATION		9	0	0	9
-		r grid interconnection, limits on operational parameters: voltage		-	-		
-	-	ions, islanding issues. Impact of grid integration with NCE so ver quality issues.	burces on existing	power s	ysten	i: ren	aointy,
stabi	iity and pov	ver quanty issues.					
TINI	ΤΙ	BASICS OF A MICROGRID		9	0	0	9
		inition of microgrid, microgrid drivers and benefits, review of	sources of microg		-	-	
	-	a microgrid, AC and DC microgrids, Power Electronics interfa	-	• 1		uuuu	ire and
com	iguiution of			merog	iius.		
UN	Τ	CONTROL AND OPERATION OF MICROGRID		9	0	0	9
		tion and control of microgrid: grid connected and islanded	mode Active and	-	v	•	-
	-	s, anti-islanding schemes: passive, active and communication-			-		
-		ower quality issues in microgrids, regulatory standards, M	-	-			
	ogrids.		C				
			Total (4	5L + 0	<b>T</b> ) =	45 P	eriods
Tex	t Books:						
1.	H. Lee W 2000.	illis and Walter G. Scott, "Distributed Power Generation – Plan	nning and Evaluation	on", Ma	rcel D	)eckei	Press,
		y Simoes and Felix A. Farret, "Renewable Energy System	ns Design and	Analysi	e wit	h Ind	luction
2.		s", CRC Press, 2004.	lis – Design and	Anarysi	IS WI	.11 111	luction
3.	Robert La	sseter and Paolo Piagi, "Micro-grid: A Conceptual Solution",	PESC, June 2004.				
Refe	erence Boo	oks:					
1.	John Twie	dell and Tony Weir, "Renewable Energy Resources", Taylor a	nd Francis Publicat	tions, 20	05.		
2.	Dorin Nea	acsu, "Power Switching Converters: Medium and High Power'	', CRC Press, Tayl	or & Fra	ancis.	2006	

3.	Amirnaser Yezdani and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and
	Applications", IEEE John Wiley Publications, 2009.
4.	F. Katiraei and M.R. Iravani, "Transients of a Micro-Grid System with Multiple Distributed Energy Resources",
	International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
5.	Z. Ye, R. Walling, N. Miller, P. Du and K. Nelson, "Facility Microgrids", General Electric Global Research Center,
	Niskayuna, New York, Subcontract report, May 2005.

Cour	se (	Dutcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Identify various forms of energy sources.	L2: Understanding
CO2	:	Recognize various DG technologies.	L2: Understanding
CO3	:	Analyse the impact on grid while integrating DGs.	L4: Analysing
CO4	:	Demonstrate the concepts of microgrids.	L3: Applying
CO5	:	Categorize various microgrid control schemes.	L4: Analysing

<b>23PTEEE3</b>	3 RESTRUCTURED POWER SYSTEM	[	SEM	EST	ER	VI
PREREQU	ISITES	CATEGORY	PE	Cr	edit	3
Power Gene	ration, Transmission and Distribution System; Power System	Hours / Week	L	Т	P	TH
Analysis and		Hours / Week	3	0	0	3
Course Ob	jectives:					
_	art knowledge on power system restructuring.					
	iliarise on electricity market models.					
	erstand various network operations / analyses including transmissi	on system operation	ons, opti	imal p	power	flov
and aut	omatic generation control.					
UNIT I	POWER SYSTEM RESTRUCTURING		9	0	0	9
	-Deregulation - Need for deregulation - Power system restructure		•		-	
	ISCOS- TO- ISO- PX- SC - trading arrangements - Operational Plan	-	PA) of E	electri	city N	Aark
rarucipants ·	Causes of restructuring- types and effects of restructuring - restru	cture models				
TINIT'T TT			0	Δ		•
UNIT II	ELECTRICAL UTILITY		9	0	<b>0</b>	9
	lity restructuring Power System Operation in competitive environments	•				
-	brid)- Components of restructured system - Power Sector restructuring	-				
-	bilities of PX- ISO- RTO and ITP - Electric Utility Market – Ma				•	
	e – Electricity Market types (energy- ancillary services- transmis	ssion- forward- rea	u time)	- Ma	arket	pow
evaluation ar	ad mitigation					
UNIT III	EVALUATION OF TRANSMISSION SYSTEM		9	0	0	9
	icing and Transmission pricing in a restructured market - Conges	tion management i	-			
• •	ansfer Capabilities (ATC) of transmission system – Application of	-		-		
	lation with sensitivity analysis method - Tagging Electricity Transa					
	and cancellation of transaction - Availability Based Tariff	66 6 I		Г		
	<b>OPTIMUM POWER FLOW (OPF) ANALYSIS IN MA</b>	RKET	_			
UNIT IV	ENVIRONMENT		9	0	0	9
Introduction	Approaches to OPF – Application of OPF analysis in Electricity	and Power Market	s with E	lectri	citv N	Aark
	- Power Flow Tracing – current decomposition axioms- Mathemat				-	
-	ransmission facilities - Methodology of graph theory - Economic is				0	
	ket environment.					
UNIT V	AGC IN RESTRUCTURED POWER SYSTEM		9	0	0	9
Introduction	- Traditional Vs Restructured Scenario -AGC in New market env	vironment - Block	diagram	and	State	Spa
representatio	n of a two-area interconnected power system in deregulated envi	ronment – Load-F	requenc	y Co	ntrol	(LFC
dynamics and	d Bilateral Contacts – Modelling- DISCO Participation Matrix (DP	M)- Generation Par	ticipatio	on Ma	trix ( <b>(</b>	GPM
		Total (4	$5L + 0^{-1}$	Г) = 4	45 Pe	riod
		×				
Text Books	:					
	ei Lai, "Power System Restructuring and deregulation", John Wile	0.0				

2.	Md. Shahidehpour and MuwaffagAlmoush, "Restructured Electric Power System - Operation- Trading and
۷.	Volatility", Marcel Dekker Inc, New York, 2001.
3.	Arthur. R. Bergen and Vijay Vittal, "Power System Analysis", Prentice Hall, New Jersey, 2000.
Refe	rence Books:
1.	Xi Fan, Wang, Yonghua Song and Malcolm Irving, "Modern Power System Analysis", Springer, 2008.
2.	D. Das, "Electrical Power Systems", New Age International (P) Ltd, New Delhi, 2008.
3.	M. Iiic, F. Galiana and L. Fink, "Power Systems Restructuring", Norwell M A Kluwer, 1998.
4.	L.Philipson and Willis H. Le, "Understanding Electric Utilities and de-regulation", Marcel Dekker Inc Publishers,
	New York, 2006.

Cours	e O	utcomes:	Bloom's Taxonomy
Upon c	omp	pletion of this course, the students will be able to:	Mapped
CO1	:	Recognize components in restructured power system.	L2: Understanding
CO2	:	Interpret various models in electricity market.	L3: Applying
CO3	:	Examine the congestion management and ATC in transmission system.	L4: Analysing
CO4	:	Formulate the power flow problem in restructured power system.	L4: Analysing
CO5	:	Develop automatic generation control in restructured power system.	L4: Analysing

23PTE	EEE3	4	POWER QUALITY		SEM	IEST	ER	VI
PRER	EQU	ISIT	ES	CATEGORY	PE	Cr	edit	3
Power (	Genera	ation	Transmission and Distribution system, Power System	Horne / Weels	L	Т	Р	TH
Protecti	ion an	d Sw	itchgear	Hours / Week	3	0	0	3
Cours	e Obj	jectiv	/es:					
1. T	o intro	oduce	the power quality terms and definitions					
2. T	o und	erstar	d the sources and issues of various power quality problems.					
3. T	o gain	ı in-d	epth knowledge of the mitigation/ suppression techniques of v	oltages sags, inter	ruption	s and	harm	onics
4. T	o intro	oduce	the computer tools for transient's analysis.					
5. T	lo expo	ose th	e various methods of power quality monitoring.					
UNIT	Ι	INT	<b>RODUCTION TO POWER QUALITY</b>		9	0	0	9
			aration voltage variations, voltage Imbalance, waveform distortion of power quality- Power Acceptability curves:	-		row		
UNIT	T II		LTAGE SAGS AND LONG DURATION VOLTAGE RIATIONS	E	9	0	0	9
Sources	s of sa	igs ar	d interruptions, estimating voltage sag performance, fundame	ental principles of	voltage	sag	Protec	ction
voltage	e sag m	nitigat	ion solution at the End-User level- Evaluating the economics o	f different ride-thr	ough al	ternat	ives -	Moto
Starting	g sags.							
Long I	Durati	ion v	oltage variations: Principles of regulating the voltage – dev	vices for voltage	regulati	on-ut	ility v	oltag
-			on- capacitor for voltage regulation- End user capacitor app	-	-		-	-
techniq								8
	-							
UNIT	III	TR	ANSIENT OVERVOLTAGE		9	0	0	9
Sources	s of tr	ansie	nt over voltage- Principles of overvoltage Protection- Device	es for mitigation of	of over	voltag	ges –	Utilit
capacito	or-swi	itchin	g transients – Utility system lightning protection - Managi	ing Ferro resonan	ice- sw	itchin	ig trai	nsient
problen	ns wit	h loa	ls - computer tools for transients analysis: PSCAD and EMTP					
					1	1	r	
UNIT			RMONICS		9	0	0	9
			Harmonics: Harmonic Distortion, voltage versus current					
	-		equences- triplen harmonics -harmonic indices, harmonic sour					
Locatin	ıg harı	moni	e sources - power system response characteristics - Effects of	of Harmonics Dist	ortion -	-Inter	harm	onics
harmon	nic dis	tortic	n evaluations, Principles and devices for controlling harmon	ic distortion, IEE	E and	IEC s	tanda	rds o
harmon	nics.							
							-	
UNIT			WER QUALITY MONITORING		9	0	0	9
	-		lerations - power quality measurement equipment: disturb	•	pectrun	1 and	l harr	nonic
analyse	ers, flic	cker 1	neters, applications of Intelligent system for power quality mo	nitoring				
				Total (4:	-1 . 0			miad
						- ('I	<i>15</i> D.	
				10tal (4.	SL + 0	Γ) = ·	45 Pe	1100
				10tal (4.	5L + 0	<b>(</b> ) =	45 Pe	1100

Tex	t Books:
1.	Roger. C. Dugan, Mark. F. McGranaghan, Surya Santoso and H.Wayne Beaty, "Electrical Power Systems Quality", Tata McGraw Hill Publishing Company Ltd, New Delhi, Third Edition, 2012.
Ref	erence Books
1.	C. Sankaran, "Power Quality", CRC Press, First Indian Edition, 2009.
2.	G.T. Heydt, "Electric Power Quality", Stars in a Circle publishers, Second Edition, 2011.
3.	Arindam Ghoshand and Gerald Ledwich, "Power Quality Enhancement Using Custom Power Devices", Springer-
	Verlag Publishers, New York Inc., Second Edition.2002.
E-R	eference:
1	www.onlinecourses.nptel.ac.in
2	www.class-central.com
3	www.mooc-list.com

Cours	se (	Outcomes:	<b>Bloom's Taxonomy</b>
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Recite the definitions and characterization of various power quality issues.	L1: Remembering
CO2	:	Discuss the sources of sag & long duration voltage variations and its control methods	L2: Understanding
CO3	:	Summarize the sources of transient overvoltage and principle of control methods	L2: Understanding
CO4	:	Understand about harmonics problem and apply filters to suppress harmonics in distribution system	L3: Applying
CO5	:	Demonstrate the operation and application of power quality measuring equipment.	L3: Applying

PREREQUISITESCATEGORYPECredit3Power Generation, Transmission and Distribution SystemsHours / WeekLTPTH3003Course Objectives:To familiarize with operation of various power plantsUNIT ITHERMAL POWER PLANT9009Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feedheater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009009
Power Generation, Transmission and Distribution Systems       Hours / Week       3       0       0       3         Course Objectives:       To familiarize with operation of various power plants       To familiarize with operation of various power plants       9       0       0       9         UNIT I       THERMAL POWER PLANT       9       0       0       9         Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- governing system for thermal stations.         UNIT II       HYDRO POWER PLANT       9       0       0       9         Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a       9       0       0       9
Course Objectives:         To familiarize with operation of various power plants         UNIT I       THERMAL POWER PLANT         9       0       0         Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- governing system for thermal stations.         UNIT II       HYDRO POWER PLANT       9       0       0       9         Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
To familiarize with operation of various power plants         UNIT I       THERMAL POWER PLANT       9       0       0       9         Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.         UNIT II       HYDRO POWER PLANT       9       0       0       9         Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a       0       9
UNIT ITHERMAL POWER PLANT9009Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a900
Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
Thermal Stations- layout- main components- boiler- economizer- air preheater- super heater- reheater- condenser- feed heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
heater- cooling powers- FD and ID fans- Coal handling plant-water treatment plant- Ash handling plant- Types of boilers and their characteristics- Steam turbines- and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
and their characteristics- governing system for thermal stations.UNIT IIHYDRO POWER PLANT9009Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
UNIT IIHYDRO POWER PLANT909Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
Hydro Electric Stations- Selection of site- layout- classification of hydro plants- general arrangement and operation of a
hydro-plant- governing system for hydel plant- types of turbines-pumped storage plants.
UNIT IIINUCLEAR POWER PLANT909
Nuclear power plants - Principles of nuclear energy -Working of Nuclear Reactors: Boiling Water Reactor (BWR),
Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal
Cooled Reactors - location - advantages and disadvantages of nuclear power plants - Reactor control
UNIT IVPOWER FROM RENEWABLE ENERGY9009
Principle, Construction and working of Solar Thermal, Solar Photo Voltaic (SPV), Wind, Tidal, Geothermal, Biogas and
Fuel Cell power systems.
POWER PLANT ECONOMICS AND ENVIRONMENTAL
UNIT V HAZARDS
Economics of power generation -Capital & Operating Cost of different power plants. Environmental aspect of power
generation- Comparison of site selection criteria, relative merits & demerits of different plants -Pollution control
technologies including Waste Disposal Options for Coal and Nuclear Power Plants- safety measures for Nuclear Power
plants.
Total (45L + 0T) = 45 Periods
Text Books:
<ol> <li>P.K. Nag, "Power Plant Engineering", 4<sup>th</sup> ed., Tata McGraw-Hill, 2017.</li> <li>S. Domkundwar, "Power Plant Engineering", Dhanpat Rai &amp; Sons, 2016.</li> </ol>
2.       S. Donkundwar, Power Plant Engineering, Dhanpar Kar & Sons, 2010.         3.       M.M. El-Wakil, "Power Plant Technology", McGraw-Hill Book Co, 2002.
Reference Books:
1. M.V. Deshpande, "Elements of Electrical Power Station Design", Pitman, New Delhi, Tata McGraw Hill, 2008.
2. Soni Gupta, Bhatnagar and Chakrabarti, "A Text Book on Power Systems Engineering", Dhanpat Rai and Sons, New Delhi, 1997.

Cours	Course Outcomes:			
Upon	Upon completion of this course, the students will be able to:			
CO1	:	Recall the construction and principle of working for different power plants.	L1: Remembering	
CO2	:	Identify the site requirements and component requirements.	L2: Understanding	
CO3	:	Analyze the concept governors and their control of power plant.	L4: Analysing	
CO4	:	Assess the power plant and its suitability for the environment.	L3: Applying	
CO5	:	Interpret the economics involved in design of power plant.	L2: Understanding	

<b>23PTEEE41</b>	INDUSTRIAL ELECTRICAL SYSTE	EMS	SEMESTER		VII	
PREREQUIS	ITES	CATEGORY	PE	Cre	dit	3
Distribution S.	vision Magguramants and Instrumentation	Hours / Week	L	Т	Р	TH
Distribution Sy	stem, Measurements and Instrumentation	nours / week	3	0	0	3
Course Object	tives:					
	ize the electrical components, safety equipment, residentia	al and commercial i	installa	tions,	illum	ination
systems and	d automation in Electrical Systems					
UNIT I	ELECTRICAL SYSTEM COMPONENTS		9	0	0	9
	ng components - Selection of cables, wires, switches, di	stribution box, met	-	system	, Pro	-
	se, MCB, MCCB, ELCB, RCCB – Construction and working					
	ical safety practices, Single Line Diagram (SLD) of wiring s				<i>.</i>	
	COMMERCIAL ELECTRICAL SYSTEMS		9		0	9
UNIT II		tion load salaulation	-	<b>0</b>	<b>0</b>	
	rcial wiring systems, general rules and guidelines for installang of main switch, distribution board and protection devices,					
	allation, earthing of commercial installation.	carting system call	Julation	is, ieqi	uneill	ients 01
commercial msu	maton, cartining of commercial instantation.					
UNIT III	ILLUMINATION SYSTEMS		9	0	0	9
Understanding v	arious terms regarding light, lumen, intensity, candle power,	1 0.01 1				
	arous terms regarding right, fumen, intensity, candle power,	lamp efficiency, spe	ecific co	onsum	ption	, glare,
space to height r	atio, waste light factor, depreciation factor, various illuminat					
luminaries like (	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illumination	ion schemes, Incand	escent	lamps	and 1	modern
luminaries like (	atio, waste light factor, depreciation factor, various illuminat	ion schemes, Incand	escent	lamps	and 1	modern
luminaries like ( residential and c	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting.	ion schemes, Incand n systems, design o	escent f a ligh	lamps	and 1	modern le for a
luminaries like ( residential and c UNIT IV	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illuminatic ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b>	ion schemes, Incand n systems, design o RES	f a ligh	lamps nting se	and 1 chem	modern le for a 9
luminaries like ( residential and c UNIT IV HT connection,	atio, waste light factor, depreciation factor, various illuminate CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial lo	ion schemes, Incand on systems, design o RES pads, motors, startin	f a light	lamps nting so 0 motors	and 1 chem 0 5, Lig	moderr le for a 9 ghtning
uminaries like ( residential and c UNIT IV HT connection, Protection, Earth	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illuminatic ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b>	ion schemes, Incand n systems, design o RES Dads, motors, startin e of compensation, In	f a light	lamps nting so 0 motors	and 1 chem 0 5, Lig	moderr le for a 9 ghtning
uminaries like ( residential and c <b>UNIT IV</b> HT connection, Protection, Earth panels. Specifica	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial le ing design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components	ion schemes, Incand n systems, design o RES Dads, motors, startin e of compensation, In	escent f a light	lamps nting so <b>0</b> motors etion to	and 1 chem 0 s, Lig PCC	9 ghtning
uminaries like ( residential and c UNIT IV HT connection, Protection, Earth panels. Specifica UNIT V	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illuminatic ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial lo ing design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components <b>ELECTRICAL SYSTEM AUTOMATION</b>	ion schemes, Incand n systems, design o <b>RES</b> bads, motors, startin e of compensation, In	escent i f a ligh 9 ng of n ntroduc 9	lamps nting so 0 motors ction to	and 1 chem 0 s, Lig PCC 0	moderr le for a 9 ghtning C, MCC 9
luminaries like ( residential and control of the second se	atio, waste light factor, depreciation factor, various illuminat CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial le ing design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components	ion schemes, Incand n systems, design o <b>RES</b> bads, motors, startin e of compensation, In	escent i f a ligh 9 ng of n ntroduc 9	lamps nting so 0 motors ction to	and 1 chem 0 s, Lig PCC 0	moderr te for a 9 ghtning C, MCC 9
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luminaries like ( residential and contrast of the contrast of	atio, waste light factor, depreciation factor, various illuminate CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial leading design, Power factor correction – kVAR calculations, type ations of LT Breakers, MCB and other LT panel components <b>ELECTRICAL SYSTEM AUTOMATION</b> LC, Role of PLC in automation, advantages of process autom	ion schemes, Incand n systems, design o <b>RES</b> bads, motors, startin e of compensation, In dation, PLC based cor	escent if a light of a	lamps nting so <b>0</b> motors etion to <b>0</b> stem d	and 1 chem 0 s, Lig 0 PCC 0 lesign	modern e for a 9 ghtning C, MCC 9 n, Pane
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Iuminaries like (residential and cresidential and created the comparison of the comparison of the created and crea	atio, waste light factor, depreciation factor, various illumination CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial leading design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components <b>ELECTRICAL SYSTEM AUTOMATION</b> LC, Role of PLC in automation, advantages of process autom uction to SCADA system for distribution automation. and G.C. Garg, "Electrical Wiring, Estimating & Costing", J a, "Electrical Design, Estimating & Costing", New age Intern	ion schemes, Incand n systems, design o <b>RES</b> bads, motors, startin e of compensation, In ation, PLC based con <b>Total (4</b> <u>Khanna publishers, 2</u> hational, 2007. Rai and Co., 1997.	scent if a light generation of the second se	lamps nting so <b>0</b> motors etion to <b>0</b> stem d	and 1 chem 0 s, Lig 0 PCC 0 lesign	moderr e for a 9 ghtning C, MCC 9 n, Pane
Iuminaries like (         residential and c         UNIT IV         HT connection,         Protection, Earth         panels. Specifica         UNIT V         Study of basic Pl         Metering, Introd         Text Books:         1.       S.L. Uppal         2.       K. B. Raina         3.       S. Singh ar         4.       H. Joshi, "	atio, waste light factor, depreciation factor, various illumination CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial lea- ing design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components <b>ELECTRICAL SYSTEM AUTOMATION</b> LC, Role of PLC in automation, advantages of process autom uction to SCADA system for distribution automation. and G.C. Garg, "Electrical Wiring, Estimating & Costing", I a, "Electrical Design, Estimating & Costing", New age Interned R. D. Singh, "Electrical estimating and costing", McGraw H Residential Commercial and Industrial Systems", McGraw H	ion schemes, Incand n systems, design o <b>RES</b> bads, motors, startin e of compensation, In ation, PLC based con <b>Total (4</b> <u>Khanna publishers, 2</u> hational, 2007. Rai and Co., 1997.	scent if a light generation of the second se	lamps nting so <b>0</b> motors etion to <b>0</b> stem d	and 1 chem 0 s, Lig 0 PCC 0 lesign	moderr e for a 9 ghtning C, MCC 9 n, Pane
Iuminaries like (         residential and c         UNIT IV         HT connection,         Protection, Earth         panels. Specifica         UNIT V         Study of basic PI         Metering, Introd         I.         S.L. Uppal         2.       K. B. Raina         3.       S. Singh ar         4.       H. Joshi, "I         Reference Boo       1.	atio, waste light factor, depreciation factor, various illumination CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. PROTECTION AND COMPENSATION MEASU industrial substation, Transformer selection, Industrial lea- ing design, Power factor correction – kVAR calculations, typ ations of LT Breakers, MCB and other LT panel components ELECTRICAL SYSTEM AUTOMATION LC, Role of PLC in automation, advantages of process autom uction to SCADA system for distribution automation. and G.C. Garg, "Electrical Wiring, Estimating & Costing", I a, "Electrical Design, Estimating & Costing", New age Interned R. D. Singh, "Electrical estimating and costing", Dhanpat Residential Commercial and Industrial Systems", McGraw H bks: rt and Science of Utilization of Electrical Energy".	ion schemes, Incand n systems, design o RES bads, motors, startin e of compensation, In- ation, PLC based con Total (4 Khanna publishers, 2 national, 2007. Rai and Co., 1997. iill Education, 2008.	escent         f a light         9         ng of n         ntroduct         9         ntrol sy         5L + 0         2008.	lamps         ting so         nting so         motors         tion to         stem d         DT) =	and 1 chem 0 3, Lig PCC 0 lesigr 45 P	moderr e for a 9 ghtning C, MCC 9 n, Pane eriods
UNIT IV HT connection, Protection, Earth panels. Specifica UNIT V Study of basic Pl Metering, Introd	atio, waste light factor, depreciation factor, various illuminatic CFL, LED and their operation, energy saving in illuminatic ommercial premises, flood lighting. <b>PROTECTION AND COMPENSATION MEASU</b> industrial substation, Transformer selection, Industrial le ing design, Power factor correction – kVAR calculations, typ tions of LT Breakers, MCB and other LT panel components <b>ELECTRICAL SYSTEM AUTOMATION</b> LC, Role of PLC in automation, advantages of process autom uction to SCADA system for distribution automation. and G.C. Garg, "Electrical Wiring, Estimating & Costing", J a, "Electrical Design, Estimating & Costing", New age Intern ad R. D. Singh, "Electrical estimating and costing", McGraw H <b>bks:</b> rt and Science of Utilization of Electrical Energy". / Taylor, "Utilization of Electrical Energy", Oriented Longm	ion schemes, Incand n systems, design o <b>RES</b> Dads, motors, startin e of compensation, In ation, PLC based con <b>Total (4</b> <u>Khanna publishers, 2</u> national, 2007. Rai and Co., 1997. fill Education, 2008. ans Limited, (Revise	escent         f a light         g         ng of n         ntroduct         g         ntrol sy         5L + 0         2008.         ed in SI	lamps         ting s         nting s         nt	and 1 chem 0 3, Lig PCC 0 45 P	moderrie for a 9 ghtning C, MCC 9 n, Pane eriods 71.
Iuminaries like ( residential and c UNIT IV HT connection, Protection, Earth panels. Specifica UNIT V Study of basic Pl Metering, Introd	atio, waste light factor, depreciation factor, various illumination CFL, LED and their operation, energy saving in illumination ommercial premises, flood lighting. PROTECTION AND COMPENSATION MEASU industrial substation, Transformer selection, Industrial lea- ing design, Power factor correction – kVAR calculations, typ ations of LT Breakers, MCB and other LT panel components ELECTRICAL SYSTEM AUTOMATION LC, Role of PLC in automation, advantages of process autom uction to SCADA system for distribution automation. and G.C. Garg, "Electrical Wiring, Estimating & Costing", I a, "Electrical Design, Estimating & Costing", New age Interned R. D. Singh, "Electrical estimating and costing", Dhanpat Residential Commercial and Industrial Systems", McGraw H bks: rt and Science of Utilization of Electrical Energy".	ion schemes, Incand n systems, design o <b>RES</b> Dads, motors, startin e of compensation, In ation, PLC based con <b>Total (4</b> <u>Khanna publishers, 2</u> national, 2007. Rai and Co., 1997. fill Education, 2008. ans Limited, (Revise	escent         f a light         g         ng of n         ntroduct         g         ntrol sy         5L + 0         2008.         ed in SI	lamps         ting s         nting s         nt	and 1 chem 0 3, Lig PCC 0 45 P	modern e for a 9 ghtning C, MCC 9 h, Panel eriods

Cour	se (	Bloom's Taxonomy			
Upon	con	Mapped			
CO1	:	Associate the various components of industrial electrical system	L2: Understanding		
CO2	:	Apply appropriate criteria for selection and sizing of the different electrical systems.	L3: Applying		
CO3	:	Recall the various terms and factors for illuminations systems	L1: Remebering		
CO4	:	Analyse the essential safety, protection and compensation measures.	L4: Analysing		
CO5	:	Select the appropriate electrical system for automation.	L4: Analysing		

23P	TEEE4	2 MODERN ELECTRICAL DRIV	L DRIVES SEMESTER VII			VII	
PRE	REQU	ISITES	CATEGORY	PE	Cr	edit	3
Elect	rical Dri	ves and Control	Hours / Week	L	T	P	TH
	01			3	0	0	3
		ectives:					
1.		by about the overview of Electrical drives.					
2. 3.	<ol> <li>To know about the Vector control strategies for DC motor drives.</li> <li>To understand the concepts of various DSP based control.</li> </ol>						
5.	10 ullo	terstand the concepts of various DSF based control.					
UNI	ТІ	DC MOTOR DRIVES		9	0	0	9
Mode	eling of	DC motors, State space modeling, block diagram & Transfe	r function, Single p	hase, tl	hree j	phase	s fully
		d half controlled DC drives. Dual converter control of DC drives		l of sepa	aratel	y exc	ited dc
moto	r drive.	Supply harmonics and ripple in motor current chopper-controlled	DC motor drives.				
TINIT	тп	INDUCTION MOTOR DRIVES		9	0	Δ	0
UNI Diffe		INDUCTION MOTOR DRIVES asformations and reference frame theory, modeling of induction	n machinas voltage	-	0		9
		or control, direct torque and flux control (DTC)	in machines, voltage	ieu ili	verter	com	101-1/1
contr	01, 1000	reonation, anote torque and num control (DTC)					
UNI	T III	SYNCHRONOUS MOTOR DRIVES		9	0	0	9
Mode	eling of	synchronous machines, open loop v/f control, vector control, dire	ct torque control, CS	I fed sy	nchro	onous	motor
drive	s.						
			SWEGHED		1		
UNI	T IV	PERMANENT MAGNET MOTOR AND RELUCTANCE MOTOR DRIVES	SWITCHED	9	0	0	9
Mode	ling of	synchronous machines, open loop v/f control, vector control, dire	ct torque control CS	I fed sy	unchro	nous	motor
	-	us topologies for SRM drives, comparison, Closed loop speed an	-	•	nem	mous	motor
			1				
UNI	ΤV	DSP BASED MOTION CONTROL		9	0	0	9
		in motion control, various DSPs available, realization of some ba	sic blocks in DSP for	impler	nenta	tion o	f DSP
based	l motion	control.					
			Total (4	T 1 0'	<b>T</b> ) _	45 D.	miada
			10tal (4:	$\mathbf{D}\mathbf{L} + \mathbf{U}$	1)=	45 P(	erious
<b>T</b> (	<b>.</b>						
Text	Books:						
1.	1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.						
2.		Trause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric N	Iachinery and Drive	System	s", Jo	hn W	'iley &
	Sons, 2	2013.					
Refe	rence B	ooks:					
1.	Н. А. ′	Faliyat and S. G. Campbell, "DSP based Electromechanical Mot	on Control", CRC p	ress, 20	03		
2.		hnan, "Permanent Magnet Synchronous and Brushless DC moto	or Drives", CRC Pres	s, 2009			
3.	https://	'nptel.ac.in/courses/					

Cours	se C	Bloom's Taxonomy	
Upon	Upon completion of this course, the students will be able to:		Mapped
CO1	:	Apply Power converters for DC drives.	L1: Remembering
CO2	:	Understand the basics of Permanent magnet motor and Switched reluctance motor drives.	L2: Understanding
CO3	:	Learn the concepts of Synchronous motor drives.	L5: Evaluating
CO4	:	Gain knowledge of Induction motor drives.	L4: Analyzing
CO5	:	Explain DSP based motion control.	L3: Applying

23P	ГЕЕЕ4.	3 MULTILEVEL POWER CONVERTE	RS	SEM	EST	ER	VII
PRE	REQU	SITES	CATEGORY	PE	Cre	edit	3
Powe	r Electro	nics	Hours / Week	L	Т	Р	TH
1000	1 Electro		Hours / Week	3	0	0	3
Cour	rse Obj	ectives:					
1.	To intr	oduce the fundamentals of multilevel voltage source inverters and	l multilevel current	source	inver	ters w	vith its
	modula	tion control					
UNI	ΓI	DIODE-CLAMPED MULTILEVEL INVERTERS		9	0	0	9
Three	e-Level I	nverter - Converter Configuration and Switching State, Space Vec	ctor Modulation - S	tationa	ry Spa	ace V	ectors,
Dwel	l Time C	alculation and Switching Sequence Design, Neutral-Point Voltag	e Control 164				
		Space Vector Modulation, SVM Based on Two-Level Algorith	nm, High-Level Di	ode-Cla	ampec	l Inve	rters -
Four-	and Five	e-Level Diode-Clamped Inverters					
	<b>T T</b>			0		0	0
UNI		MULTILEVEL VOLTAGE SOURCE INVERTERS		9	0	0	9
		NPC/H-Bridge Inverter, Inverter Topology and Modulation Sch ring-Capacitor Inverters, Inverter Configuration, Modulation Sche		and H	armor	ne Co	ontent,
Multi	level Fly	ing-capacitor inverters, inverter Configuration, Modulation Sche	lines				
UNI	тш	CASCADED MULTILEVEL INVERTERS		9	0	0	9
		erter, Bipolar Pulse-Width Modulation and Unipolar Pulse-Width	Modulation, CHB	-	-		
	-	Bridges with Unequal DC Voltages, Carrier Based PWM Schem				-	
	-	Multicarrier Modulation, Comparison Between Phase- and Level					,
UNI		MODULAR MULTILEVEL INVERTER		9	0	0	9
		dular Multilevel Inverter- Power circuit, operation and applications	, DC Voltage balan	ce cont	rol, C	arrier	Based
PWM	I for Mo	dular Multilevel Inverter					
TINIT	тх			0	0	Δ	0
UNI		<b>PWM TECHNIQUES</b> Addulation, Selective Harmonic Elimination, Space Vector Mo	dulation Switching	9 Statas	0	<b>0</b>	9
		alculation, Switching Sequence, Harmonic Content	unation-Switching	States	, spa	e ve	ctors,
Dwei		acculation, Switching Sequence, Harmonie Content					
			Total (45	5L + 0'	$\mathbf{T}$ ) = 4	45 Pe	eriods
					,		
Text	Books:						
1	Bin V	Vu and Mehdi Narimani, "High-Power Converters and AC Drives	" 2nd Edition Wil	ev-IFF	F Pre	ss 20	17
1.	DIII V	vu and Mendi Narimani, Trigi-10wer Converters and AC Drives	, 2nd Edition, wh	Cy-ILL		33, 20	17.
Refe	rence B	ooks:					
1.	N. Mohan, T. M. Undeland, et al., "Power Electronics-Converters, Applications and Design", 3rd edition, John						
1.	Wiley	/ & Sons, New York, 2003.					
E-Re	eference	:					
1.	https:	//archive.nptel.ac.in/courses/108/102/108102157/					
L	1						

Cours	Course Outcomes:		
Upon	Upon completion of this course, the students will be able to:		Mapped
CO1	:	Understand the configurations for multilevel voltage source inverters.	L1: Remembering
CO2	:	Describe the working principle of multilevel current source inverters	L2: Understanding
CO3	:	Draw the topology structure of different types of multilevel inverters	L3: Applying
CO4	:	Understand the principle of space vector modulation for multilevel inverters	L1: Remembering
CO5	:	Select an appropriate modulation scheme for multilevel inverters	L4: Analyzing

23PTEEE44 MODELLING AND CONTROL OF POWER CONVERTERS			NVERTERS	SEMESTER			VII
PRI	EREQU	ISITES	CATEGORY	PE	Cre	edit	3
Dou	vor Eloc	tronics and Control Systems	Hours / Week	L	Т	Р	TH
FOW	ver Liec	formes and control systems	Hours / week	3	0	0	3
Cou	ırse Ob	jectives:					
1.		n the basics of control system simulation.					
2.	To do :	symbolic calculation and study the principles of sliding mode co	ontrol and the way	of app	oly sn	nc for	buck
	convert						
3.		n the concept of power factor correction.					
4.	To desi	gn simulate smc for buck converter and power factor correction cir	cuit with controller	,			
					-		
	IT I	SIMULATION BASICS IN CONTROL SYSTEMS		9	0	0	9
		ction-How to build transfer function, identify Poles, zeros, draw tir		-			
	-	n Factors, Constant, Single and Double Integration Function	-				
		Single Pole and Single Zero Functions, RHP Pole and RHP	Zero Functions),	state s	pace	mode	elling-
trans	sfer func	ction from state space model.					
					-	-	-
	IT II	SYMBOLIC CALCULATIONS		9	0	0	9
		riables - Symbolic Vector Variables, Commands for Handling Pol					
-		. Factorization and Roots of Polynomials, Symbolic Matrix Alge	bra - Operations w	ith Syr	nboli	e Mat	rices -
Othe	er Symbo	blic Matrix Operations.					
	IT III	SLIDING MODE CONTROL BASICS		9	0	0	9
		Introduction to Sliding-Mode Control- Basics of Sliding-Mode Th	neory- Application of	of Slidi	ng-M	ode C	ontrol
to D	C-DC C	onverters—Principle-Sliding mode control of buck converter.					
					-		0
	IT IV	POWER FACTOR CORRECTION CIRCUITS		9	0	0	9
		Operating Principle of Single-Phase PFCs, Control of boost co			-	-	Inner
Ave	rage-Cur	rent-Control Loop, Designing the Outer Voltage-Control Loop, Ex	ample of Single-Ph	ase PF	C Sys	stems.	
					-	-	-
	IT V	CONTROLLER DESIGN FOR PFC CIRCUITS		9	0	0	9
		correction circuit using other SMPS topologies: Cuk and SEPIC co	onverter - PFC circu	its emp	loyin	g brid	geless
topo	ologies.						
			T-4-1 (15	T . 07	<b>P</b> )	45 D.	
			Total (45	L + 0'.	<b>(</b> ) = 4	45 Pe	llous
	( <b>D</b> )		Total (45	L + 07	Γ) = ·	45 Pe	11005
Tex	t Books						
<b>Tex</b> 1.	Dean	Frederick and Joe Chow, "Feedback Control Problems using MA					
1.	Dean Cenga	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000.	TLAB and the Cor				
	Dean Cenga Ned N	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000. Mohan, "Power Electronics: A First Course", John Wiley, 1 <sup>st</sup> Edition	TLAB and the Cor n, 2013.	trol Sy	vstem	Tool	Box",
1.	Dean Cenga Ned Maria	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000. Johan, "Power Electronics: A First Course", John Wiley, 1 <sup>st</sup> Edition n K. Kazimierczuk and Agasthya Ayachit, "Laboratory Manual t	TLAB and the Cor n, 2013.	trol Sy	vstem	Tool	Box",
1. 2. 3.	Dean Cenga Ned M Maria Conve	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000. Mohan, "Power Electronics: A First Course", John Wiley, 1 <sup>st</sup> Edition n K. Kazimierczuk and Agasthya Ayachit, "Laboratory Manual f erters", Wiley, 1 <sup>st</sup> Edition, 2016.	TLAB and the Cor n, 2013. for Pulse-Width Me	trol Sy odulate	vstem d DC	Tool	Box",
1. 2. 3. 4.	Dean Cenga Ned M Maria Convo S.K.V	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000. Mohan, "Power Electronics: A First Course", John Wiley, 1 <sup>st</sup> Edition n K. Kazimierczuk and Agasthya Ayachit, "Laboratory Manual f erters", Wiley, 1 <sup>st</sup> Edition, 2016. Tarenina, "Power Electronics handbook", Industrial Electronics Ser	TLAB and the Cor n, 2013. for Pulse-Width Me	trol Sy odulate	vstem d DC	Tool	Box",
1. 2. 3. 4.	Dean Cenga Ned M Maria Convo S.K.V	Frederick and Joe Chow, "Feedback Control Problems using MA age Learning, 1 <sup>st</sup> Edition, 2000. Mohan, "Power Electronics: A First Course", John Wiley, 1 <sup>st</sup> Edition n K. Kazimierczuk and Agasthya Ayachit, "Laboratory Manual f erters", Wiley, 1 <sup>st</sup> Edition, 2016. Tarenina, "Power Electronics handbook", Industrial Electronics Ser	TLAB and the Cor on, 2013. for Pulse-Width Ma ies, CRC Press, 1 <sup>st</sup>	trol Sy odulate Edition	d DC	Tool	Box", Power

2.	Andre Kislovski, "Dynamic Analysis of Switching-Mode DC/DC Converters", Springer 1991.
3.	Lopez Cesar, "MATLAB Symbolic Algebra and Calculus Tools", Apress, 2014.

Cour	se O	Bloom's Taxonomy	
Upon	Upon completion of this course, the students will be able to:		Mapped
CO1	:	To calculate transfer function for constant, differential, integral, First order and Second order factors.	L2: Understanding
CO2	:	To illustrate the effect of poles and zero's in the 's' plane.	L1: Remembering
CO3	:	To select Symbolic equations for solving problems related with Matrices, Polynomial and vectors.	L5: Evaluating
CO4	:	To compute the control expression for DC – DC buck converter using sliding mode control theory	L3: Applying
CO5	:	To determine the controller expression for power factor correction circuits and to simulate sliding mode control of buck converter and power factor correction circuit.	L5: Evaluating

23D	reee45	CONTROL AND INTEGRATION OF RENEWABLE ENERGY		SEM	VII		
231	LEE45	SOURCES		SEN	IESI		VII
PRE	REQUIS	SITES	CATEGORY	PE	Cr	edit	3
NIL			Hours / Week	L	Τ	Р	TH
				3	0	0	3
Cou	rse Obje	ctives:					
1.	To unders	tand electric power Generation, Transmission and Distribution					
2.	To study I	Power System Operation and Control					
	T						1
UNI		NTRODUCTION		9	0	0	9
	-	tility ideal features, Supply guarantee, power quality, Stability an	-				wable
Energ	gy penetra	tion into the grid, Boundaries of the actual grid configuration, Co	nsumption models	and pat	tterns	•	
UNI	тп (	CONVENTIONAL ENERGY CONVERSION TECHNO	DLOGIES	9	0	0	9
		pes of conventional and nonconventional dynamic generation		-	v		-
		procating engines, gas and micro turbines, hydro and wind based	0 1		or op	ciulio	ii uiiu
TINIT		ION-CONVENTIONAL ENERGY CONVERSION		9	0	0	9
UNI	T III   T	TECHNOLOGIES		9	U	U	9
	•	pes of conventional and nonconventional static generation technology		-			•
	-	provoltaic systems and wind generation technologies; MPPT tech	-		-	-	-
opera	ition and p	artial shading effects; Storage Technologies - batteries, fly wheel	s, super capacitors	and ult	ra-ca	pacito	ors.
UNI	T IV C	CONTROL ISSUES AND CHALLENGES		9	0	0	9
		linear controllers, predictive controllers and adaptive controllers,	Load frequency and	d Volta	ge Co	-	
		chniques, Control of Diesel, PV, wind and fuel cell-based gene			-		
throu	gh Capabi	lities.					
UNI		NTEGRATION OF ENERGY CONVERSION TECHN		9	0	0	9
		importance, sizing, Optimized integrated systems, Interfacing re	-				
		onnected Photovoltaic systems –classifications, operation, merits issues, load sharing, operation & control of hybrid energy system					•
-		nd standards for renewable energy grid integrations.		uie upj	pneut	10115.	ILLL
			Total (45)	L + 07	(1) = 4	15 Pe	riods
Text	Books:						
	G. Maste	ers, "Renewable and Efficient Electric Power Systems", IEEE-	John Wiley and So	ons Ltd	l. Puł	olisher	rs. 2 <sup>nd</sup>
1.	Edition,						~, _
2.	2 S. Chowdhury, S. P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", IET Power						
		ics Series, 2012.	1.(D 11.7	<del>.</del>			
3.	-	nani Mohammad Marwali and Min Dai, "Integration and Contro , John Wiley publishing company, 2 <sup>nd</sup> Edition, 2010.	of Renewable Ei	hergy in	n Ele	ctric I	rower
Refe	rence Bo						
		Singh Solanki, "Solar Photovoltaic: Fundamentals, Technolog	ies & Application	s", PH	I Put	olishe	rs, 3 <sup>rd</sup>
1.	Edition.	•		,			, -

2	Rabindra Kumar Satpathy and Venkateswarlu Parmuru, "Solar PV Power: Design, Manufacturing and Applications
2.	from Sand to Systems", Academic Press, 2020.
2	Quing-Chang Zhong, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", IEEE-John
5.	Wiley and Sons Ltd. Publishers, 1 <sup>st</sup> Edition, 2013.
4.	Bin Wu, Yongqiang Lang and Navid Zargari, "Power Conversion and Control of Wind Energy Systems", IEEE- John
4.	Wiley and Sons Ltd. Publishers, 1 <sup>st</sup> Edition, 2011.
5	Report on "Large Scale Grid Integration of Renewable Energy Sources - Way Forward" Central Electricity Authority,
5.	GoI, 2013.

Cour	se O	Bloom's Taxonomy	
Upon	com	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the importance of renewable energy sources.	L2: Understanding
CO2	:	Familiarize the conventional energy system.	L5: Evaluating
CO3	:	Familiarize the nonconventional energy system.	L3: Applying
CO4	:	Analyze and simulate control strategies for grid connected and off-grid systems.	L4: Analyzing
CO5	:	Develop converters to comply with grid standards to obtain grid integration.	L6: Creating

	PTEEE51	DIGITAL SIGNAL PROCESSI		SEN	1		VII
PR	EREQUIS	ITES	CATEGORY	PE	Cre		3
Sig	nals and Sy	stems, and Control systems	Hours / Week	L 3	T 0	P 0	TE 3
~	urse Objec	tives.		5	U	U	5
1.	-	fy signals and systems & their mathematical representation					
$\frac{1}{2}$		the discrete time systems.	l <b>.</b>				
<u>2.</u> 3.		about filters and their design for digital implementation.					
5.	10 study	about mens and then design for digital implementation.					
UN	IT I IN	TRODUCTION		9	0	0	9
		systems: Continuous, discrete, linear, causal, stable, dy	namic, recursive, time v	ariance	e; class	sificat	tion of
		ous and discrete, energy and power; mathematical repre-					
ecł	nniques, quar	tization, quantization error, Nyquist rate, aliasing effect. I	Digital signal representat	tion.			
		SCRETE TIME SYSTEM ANALYSIS		9	0	0	-
		its properties, inverse z-transforms; difference equation - ity analysis, frequency response – Convolution – Introduc					
	isform.	ity analysis, frequency response – Convolution – introduc		II - DIS		unie i	oun
UN	IT III D	SCRETE FOURIER TRANSFORM AND COM	PUTATION	9	0	0	9
DF	T properties,	magnitude and phase representation - Computation of DF	Г using FFT algorithm -	- DIT &	& DIF	- FFT	usir
adi	ix 2 – Butter	ly structure					
		•					
		ESIGN OF DIGITAL FILTERS	·	9	0	0	-
FIR	& IIR filter	ESIGN OF DIGITAL FILTERS realization – Parallel & cascade forms. FIR design: Windo		d and c	choice	of wi	ndov
FIR – L	& IIR filter inear phase	ESIGN OF DIGITAL FILTERS realization – Parallel & cascade forms. FIR design: Windo characteristics. Analog filter design – Butterworth and O	Chebyshev approximation	d and cons; di	choice	of wi	ndov
FIR – L	& IIR filter inear phase	ESIGN OF DIGITAL FILTERS realization – Parallel & cascade forms. FIR design: Windo	Chebyshev approximation	d and cons; di	choice	of wi	ndow
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E-F	References:
1.	https://nptel.ac.in/courses/108105055/34
2.	https://books.google.co.in/books?isbn=8131710009

Cour	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the types of systems and signals.	L2: Understanding
CO2	:	Solve problems in digital system using Z transform.	L5: Evaluating
CO3	:	Apply Fourier transforms for processing of digital signals.	L3: Applying
CO4	:	Analyze digital systems using Fast Fourier transform.	L3: Applying
CO5	:	Design digital filters algorithms in digital signal processor platforms	L5: Evaluating

23P	TEEE52	2 EMBEDDED SYSTEM DESIGN		SEM	IEST	ER	VIII
PRE	REQUI	ISITES	CATEGORY	PE	Cre	edit	3
Micr	oprocesso	or and Microcontroller, C programming	Hours / Week	L	Т	P	TH
			Hours / Week	3	0	0	3
Cou	rse Obje	ectives:					
1.	-	aint the students the building blocks of embedded system, selec	tion of various com	ponent	s for l	ouildir	ng an
		led system.					
2.		erstand different communication protocols used in embedded sys					
3.		y the different programming techniques used in embedded syste		-			
4.	To unde	erstand the concepts of operating systems that are exclusively us	ed in embedded sys	stems.			
UN	гт т	INTRODUCTION TO EMBEDDED SYSTEM		9	0	0	9
			ed Handmann Cana	-	-		
		o functional building blocks of embedded systems – Embedd					
-		mbedded System - a Microprocessor-Based System – a Micro es, ports, timer, interrupt controllers.	scontroller-based S	ystem	- DS	Р - К	egister,
mem	ory devic	es, ports, unier, interrupt controners.					
UN	IT II	PROCESSOR AND MEMORY ORGANIZATION		9	0	0	9
Struc	tural unit	ts in a processor; selection of processor and memory devices; si	hared memory; DM	IA; inte	erfacii	ng pro	cessor,
mem	ory and L	/O units; memory management – Cache mapping techniques, dy	namic allocation - I	Fragme	ntatio	on.	
UN	T III	DEVICES AND BUSES		9	0	0	9
				-			
Time	ers, Count	<b>DEVICES AND BUSES</b> ers, serial communication using I2C, CAN, USB buses- parallel of th devices/ports, device drivers in a system – Serial port & paral	communication usir	-			
Time	ers, Count	ers, serial communication using I2C, CAN, USB buses- parallel	communication usir	-			
Time inter	ers, Count	ers, serial communication using I2C, CAN, USB buses- parallel	communication usir	-			
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Time interf UNI Struc Progr	ers, Count facing wit T IV eture of Er ram, Bitw	ers, serial communication using I2C, CAN, USB buses- parallel of th devices/ports, device drivers in a system – Serial port & paral <b>EMBEDDED PROGRAMMING</b> mbedded C Program, C Program build process, Type, Storage C vise operations, Pointer variables and memory addresses, Function	communication usir lel port. lass and Scope of V	ng ISA, 9 Variable	PCI, Des, Bu	PCI/X 0 ilding	a C
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Cour	se (	Dutcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Understand the basic concepts of Embedded Systems.	L2: Understanding
CO2	:	Appreciate the general organization of Embedded Systems	L1: Remembering
CO3	:	Understand various devices required for an Embedded System Design	L2: Understanding
CO4	:	Understand the implementation of Programming techniques for Embedded System	L3: Applying
CO5	:	Know the various blocks of RTOS and its implementation in Design	L5: Evaluating

231	PTEEE	E53	ARTIFICIAL INTELLIGENCE AND COMP	UTER VISION	SEN	AEST	ER	VIII
PR	EREQ	UISI	TES	CATEGORY	PE	Cre	dit	3
Soft	t compu	ting		Hours / Week	L 3	Т 0	P 0	TH 3
Co	urse O	bjecti	ves:			Ţ	-	
1.	To un	dersta	nd the various characteristics of Intelligent agents					
2.			different search strategies in AI					
3.	To lea	arn to i	represent knowledge in solving AI problems					
4.			nd the different ways of designing software agents					
5.			out the various applications of AI					
6.	To pro	ovide	introduction to computer vision					
		T			-		-	
	IT I		TRODUCTION		9	0	0	9
			nition – Future of Artificial Intelligence – Characteristics o g Approach to Typical AI problems.	51 memgent Agents –	- Typica			Agents
UN	IT II	PR	OBLEM SOLVING METHODS		9	0	0	9
-			blems – Searching with Partial Observations – Constraint earch – Game Playing – Optimal Decisions in Games – A				-	
		8 ~						
	IT III	-	OWLEDGE REPRESENTATION		9	0	0	9
UN Firs	t Order	<b>KN</b> Predic	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward	-	rd Chai	ning –	Resol	ution –
UN Firs Kno	t Order wledge	KN Predic Repr	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward esentation – Ontological Engineering – Categories and	Objects – Events – I	rd Chai	ning –	Resol	ution –
UN Firs Kno	t Order wledge	KN Predic Repr	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward	Objects – Events – I	rd Chai	ning –	Resol	ution –
UN Firs Kno Obje	t Order owledge ects – R	KN Predic Repro	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward esentation – Ontological Engineering – Categories and ing Systems for Categories – Reasoning with Default Info	Objects – Events – I	rd Chai	ning –	Resol	ution –
UN Firs Kno Obj	t Order owledge ects – R IT IV	KN Predic Repr leason	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward esentation – Ontological Engineering – Categories and ing Systems for Categories – Reasoning with Default Info FTWARE AGENTS AND AI APPLICATIONS	Objects – Events – I prmation	rd Chai Mental	ning – Events 0	Resolution and Description of the second sec	ution – Mental 9
UN Firs Knc Obj UN Arc – Tr	t Order owledge ects – R IT IV hitecture rust and	KN Predic Repri- ceason SO e for I Reput	OWLEDGE REPRESENTATION         cate Logic – Prolog Programming – Unification – Forward         esentation – Ontological Engineering – Categories and         ing Systems for Categories – Reasoning with Default Info         FTWARE AGENTS AND AI APPLICATIONS         ntelligent Agents – Agent communication – Negotiation         tation in Multi-agent systems.	Objects – Events – Pormation	rd Chai Mental 9 gumenta	ning – Events 0 ation ar	Resolution and Department of the second seco	ution – Mental 9 Agents
UN Firs Kno Obje UN Arc: – Tr AI	t Order weledge ects – R IT IV hitecture rust and applicat	KN Predic Repr eason SO e for I Reput	OWLEDGE REPRESENTATION cate Logic – Prolog Programming – Unification – Forward esentation – Ontological Engineering – Categories and ing Systems for Categories – Reasoning with Default Info FTWARE AGENTS AND AI APPLICATIONS ntelligent Agents – Agent communication – Negotiation	Objects – Events – Pormation and Bargaining – Arg	rd Chai Mental 9 gumenta	ning – Events 0 ation ar	Resolution and Department of the second seco	ution – Mental 9 Agents
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Tex	xt Books:
1.	S. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2.	I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth Edition, Addison-Wesley Education Publishers
2.	Inc., 2011.
3	David A. Forsyth and Jean Ponce, "Computer Vision: A Modern Approach", Pearson Publications, Second Edition,
5	2012.
4	Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", Cambridge University Press,
-	Second Vision, 2004.
Ref	ference Books:
1	M. Tim Jones," Artificial Intelligence: A systems Approach (Computer science)", Jones and Bartlett Publishers Inc.,
	First Edition, 2008.
2	Nils J. Nilsson," The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3	William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using ISO standard", Fifth Edition, Springer,
	2003.
4	Gerhard Weiss, "Multi Agent systems", Second Edition, MIT Press, 2013.
5	David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge
	University Press 2010.

Cours	se (	Outcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Use appropriate search algorithms for any AI problem	L3: Applying
CO2	:	Represent using first order and predicate logic	L2: Understanding
CO3	:	Provide the apt agent strategy to solve a given problem	L4: Analyzing
CO4	:	Use Artificial Intelligence for various application	L3: Applying
CO5	:	Understand to use AI techniques in computer vision	L2: Understanding

<b>23PTEEE54</b>	SOFT COMPUTING		SEM			VII
PREREQUI	SITES CATEGOR	Y	PE	Cre	1	3
Mathematics, '	C' Programming Hours / Wee	k	L 3	Т 0	P 0	<u>TH</u> 3
Course Obje	ctives:		5	U	U	5
	e Basics of artificial neural network.					
To provid	e adequate knowledge of genetic algorithms and its application to economic d	isnat	tch and	unit c	omm	itmer
2. problems	e adequate knowledge of generie algorithms and its appreadon to economic a	isput	ten und	unite	omm	runiei
	e the students to the features of hybrid control systems					
UNIT I A	RTIFICIAL NEURAL NETWORK		9	0	0	9
Review of fun	lamentals – Biological neuron, artificial neuron, activation function, single lay	er p	erceptr	on – I	imita	tion
Multi layer per	ceptron – Back Propagation Algorithm (BPA) – Recurrent Neural Network (I	RNÑ	J) – Ād	aptive	Resc	nanc
	based network - Radial basis function network - online learning algorithm					
lgorithms – R	einforcement learning.					
				-		
	EURAL NETWORKS FOR MODELLING AND CONTROL		9	0	0	9
	ion-linear systems using ANN – Generation of training data – Optimal arch					
	-linear systems using ANN - Direct and indirect neuro control schemes -	Ada	ptive r	neuro d	contro	oller
amiliarization	with neural network toolbox.					
	UZZY SET THEORY		9	0	0	
		1:4	-	v	v	-
	ry – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardina					
	ager and Sugeno), equilibrium points, aggregation, projection, composition,	cyn	indrical	exten	sion,	Tuzz
relation – Fuzz	y membership functions.					
UNIT IV F	UZZY LOGIC FOR MODELLING AND CONTROL	Fu	9	0	0	-
UNIT IV F Modelling of r	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller		<b>9</b> zzificat	<b>0</b> tion –	0 Knov	vledg
UNIT IV F Modelling of r	UZZY LOGIC FOR MODELLING AND CONTROL		<b>9</b> zzificat	<b>0</b> tion –	0 Knov	
UNIT IV F Modelling of r base – Decision	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller n making logic – Defuzzification – Adaptive fuzzy systems – Familiarization w		<b>9</b> zzificat	<b>0</b> tion –	0 Knov	vledg
UNIT IV F Modelling of r pase – Decision UNIT V F	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller n making logic – Defuzzification – Adaptive fuzzy systems – Familiarization w	ith f	9 zzificat uzzy lo 9	0 tion – ogic too 0	0 Knov olbox	vledg
UNIT IV F Modelling of r base – Decision UNIT V F Fuzzification a	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller in making logic – Defuzzification – Adaptive fuzzy systems – Familiarization w WBRID CONTROL SCHEMES and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA –	ith f Opt	9 zzificat uzzy lo 9 imizati	0 tion – ogic too 0 on of r	0 Knov olbox 0 nemb	vledg ershi
UNIT IV F Modelling of r base – Decision UNIT V F Fuzzification a function and ru	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller n making logic – Defuzzification – Adaptive fuzzy systems – Familiarization w	ith f Opt	9 zzificat uzzy lo 9 imizati	0 tion – ogic too 0 on of r	0 Knov olbox 0 nemb	vledg ershi
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UNIT IV F Modelling of r base – Decision UNIT V F Fuzzification a function and ru	UZZY LOGIC FOR MODELLING AND CONTROL on-linear systems using fuzzy models – TSK model – Fuzzy logic controller in making logic – Defuzzification – Adaptive fuzzy systems – Familiarization w INTROL SCHEMES and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – le base using Genetic Algorithm – Introduction to other evolutionary optimizati study – Familiarization with ANFIS toolbox.	ith f Opt on te	9 zzificat uzzy lo 9 imizati	0 tion – gic too 0 on of r ies, sup	0 Knov blbox blbox olbox	vledg ershi
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Cour	se (	Dutcomes:	Bloom's Taxonomy
Upon	con	pletion of this course, the students will be able to:	Mapped
CO1	:	Ability to understand and apply basic Artificial neural network.	L2: Understanding
CO2	:	To understand and apply modelling and control of neural network.	L3: Applying
CO3	:	To remember modelling and control of fuzzy control systems.	L1: Remembering
CO4	:	Evaluate hybrid control schemes.	L5: Evaluating
CO5	:	Design a fuzzy controller.	L6: Creating

23P7	TEEE	<b>INTERNET OF THINGS FOR ELECTRIC</b>	CAL SYSTEM	SEM	IEST	<b>ER</b>	VII
PRE	REQ	UISITES	CATEGORY	PE	Cre	edit	3
Micro	oproce	ssors and microcontrollers	Hours / Week	L 3	Т 0	P 0	<u>TH</u> 3
Cour	rse Ol	bjectives:		1			
1.	To illu	ustrate the concept of Internet of Things (IoT).					
2.	To far	niliarize with implementations of IoT for electrical engineering	applications.				
UNI	TI	INTRODUCTION		9	0	0	9
Intern	net of T	Things - Definition- IoT conceptual framework-IoT architecture	and Features, Major Co	mpone	nts of	IoT S	ystem
IoT so	oftwar	e components for device hardware, Development Tools for IoT	•				
UNI	ТП	IOT DEVICES		9	0	0	9
		nsing the Real World, Analog Sensors and Digital Sensors, Sens	sors for Temperature H	umidity	7 Dist	ance	-
		iezoelectric vibrators and sounders, Speakers, Solenoids, Servor	motor, Relay switch.	0	0		
	ГШ	IOT COMMUNICATION SYSTEM		9	0	0	9
IoT/N	A2M S	munication for IoT, M2M Architecture, M2M Software and De Systems, Near-Field Communication, RFID, Bluetooth BR/ED (Cellular Networks-Mobile Internet, Differences between NFC)	OR and Bluetooth Low	Energy	y, Zig	Bee,	
IoT/N GPRS	A2M S S/GSM		OR and Bluetooth Low	Energy	y, Zig	Bee,	
IoT/N GPRS UNI	и2М S S/GSM <b>T IV</b>	Systems, Near-Field Communication, RFID, Bluetooth BR/ED I Cellular Networks-Mobile Internet, Differences between NFC	OR and Bluetooth Low , BT LE, ZigBee and W	Energy /LAN p 9	y, Zig protoc 0	Bee, ols.	Wi-Fi
IoT/M GPRS UNI Data	M2M S S/GSM T IV Acqui re Mar	Systems, Near-Field Communication, RFID, Bluetooth BR/ED I Cellular Networks-Mobile Internet, Differences between NFC IOT DATA PROCESSING AND ANALYSIS ring and Storage: Data Generation, Data Acquisition, Data Va nagement, Server Management, Database Management Syste	PR and Bluetooth Low , BT LE, ZigBee and W lidation, Data Categori em, Query Processing,	Energy /LAN I 9 zation, SQL,	y, Zig protoc 0 Data NOS	Bee, ols. 0 Store QL, 0	Wi-Fi
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Cours	Course Outcomes:				
Upon	con	Mapped			
CO1	:	Recall the structure and components of IOT system.	L1: Remembering		
CO2	:	Select an appropriate device to interface IOT system with physical world	L4: Analyzing		
CO3	:	Apply suitable communication technologies for IOT system	L3: Applying		
CO4	:	Classify the data processing schemes for IoT application	L4: Analyzing		
CO5	:	Use IOT platform for real time engineering solutions	L3: Applying		

23P'	TEEE	<b>ELECTRICAL ENERGY CONSERVATION AN</b>	D AUDITING	SEM	EST	ER	VIII
PRE	EREQ	UISITES	CATEGORY	PE	Cr	edit	3
Pow	er Ger	neration, Transmission and Distribution System	Hours / Week	L 3	Т 0	P 0	TH 3
Cou	rse O	bjectives:					-
1.	To get	t knowledge about basics of energy and energy scenario of India.					
2.	To far	niliarise the energy conservation methods.					
3.	To acc	quire knowledge on energy auditing, energy efficiency and modern	energy efficient dev	vices.			
UNI	ΤI	ENERGY SCENARIO		9	0	0	9
consu Energ	umptio gy and	I and non-commercial energy -Primary energy resources - Con on - Energy needs of growing economy - Long term energy scenari environment - Energy security - Energy conservation and its import ergy strategy for the future, air pollution, climate change. Energy Co	o - Energy pricing - ortance - Restructur	Energy	y sect he en	or ref ergy	orms -
UNI	тп	BASICS OF ENERGY		9	0	0	9
fuel,	tempe	tariff - Load management and maximum demand control - Therma rature and pressure, heat capacity, sensible and latent heat, evap heat transfer, units and conversion.					
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Cours	Course Outcomes:				
Upon	con	Mapped			
CO1	:	Identify the present energy scenario and future energy strategy.	L1: Understanding		
CO2	:	Recognize the various forms of energy.	L1: Understanding		
CO3	:	Interpret energy management methods and energy auditing.	L3: Applying		
CO4	:	Familiar in energy efficiency of electrical systems.	L4: Analysing		
CO5	:	Familiar with the advanced energy efficient technologies.	L4: Analysing		

<b>23PTEEE</b>	62 ELECTRICAL WIRING, ESTIMATION AND	COSTING	SEM	EST	ER	VIII
PREREQ	UISITES	CATEGORY	PE	Cre	edit	3
<b>Basic Elec</b>	trical Engineering	Hours / Week	L	Т	Р	TH
Dasie Liee		Hours / Week	3	0	0	3
Course Ol	ojectives:					
1 To de	scribe the fundamental electrical tools required for electrical wiring	and estimate the c	osting o	of elec	ctrical	wiring
1. for re	sidential, industrial, overhead, underground and substations.					
•						
	ELECTRICAL WIRING & GENERAL PRINCIPLES	OF	0	•	•	0
UNIT I	ESTIMATION		9	0	0	9
Guidelines	for electrical wiring – Schematic diagram of electrical wiring syst	em, sizes of wires,	, strand	ed wi	res, t	ypes of
wires, wire	splicing and termination, difference between neutral and earth	wire, General idea	about	I.E r	ule -	Indian
Electricity A	Act.					
General pri	nciples of estimation - Electrical Schedule of rates, catalogues,	Survey and source	e select	ion, F	Record	ling of
estimates Q	uantity and cost of material required. Purchase system, Purchase er	quiry and selection	n of ap	oropri	ate pi	irchase
mode, Com	parative statement, Purchase orders, Payment of bills					
UNIT II	RESIDENTIAL INSTALLATION		9	0	0	9
Guidelines	for electrical wiring installations of residential and positioning of	equipment, Circui	t desig	n in li	ightni	ng and
	its, Method of drawing single line diagram, Selection of type of wir		-		-	-
-	main switch, distribution board, cable selection, earthing, selection	• •				
-	timate, Preparation of detailed estimates and costing for residential	•	1			
1 1 8						
UNIT III	COMMERCIAL INSTALLATION		9	0	0	9
Fundamenta	l considerations for planning of electrical wiring installation for co	mmercial building	s. Desi	gn co	nside	rations.
	ations and selection of size of service connection, Deciding the s	-		-		
	f rating of main switch, distribution board, Earthing, cable sele					
	board, cable selection, earthing, selection of switchgear, Seque			-		
	of detailed estimates and costing for commercial installations.		1	1	C	
UNIT IV	<b>OVERHEAD AND UNDERGROUND DISTRIBUTION</b>	SYSTEM	9	0	0	9
Overhead d	istribution system and underground distribution system: materials	and accessories r	equired	for t	the ov	rhead
	system, estimate for 440V/3-phase/ 4 wires or 3 wires overh		-			
	, method of installation of service connection (1-phase and 3-phase		-			
service con			C			
UNIT V	SUBSTATION		9	0	0	9
	on of substation, selection and location of site for substation, main e	electrical connection	-	-	svml	
	s of apparatus and circuit elements on substation, main connection of			-	•	
	or substation and switchgear installations, substation auxiliaries su		-	1 2.01		
1. 1		1 77	0'			
		Total (4	$51. \pm 0$	<b>T)</b> –	45 P	erinds
		1 Juni (4		<b>_</b> )-	<del>1</del> .7 1	

Tex	Text Books:					
1.	K.B. Raina and S.K. Bhattacharya, "Electrical Design, estimating & Costing", New Age International (p) Limited,					
1.	New Delhi,2007.					
2.	J.B. Gupta, "Electrical Installation Estimating & Costing", S. K. Kataria& Sons, New Delhi,2015.					
3.	S.L. Uppal, "Electrical Estimating & Costing", New Age International (p) Limited, New Delhi ,2008					
Ref	erence Books:					
1.	Surjith Singh, "Electrical Estimating and Costing", Danpat Rai &Co.					
2.	CEA Regulations 2010.					
3.	I.E rules for wiring and supply act manuals.					

Cours	Course Outcomes:				
Upon	Upon completion of this course, the students will be able to:				
CO1	:	Recall the guidelines for electrical wiring installations.	L1: Remembering		
CO2	:	Apply appropriate select criteria and sizing of the electrical wiring for different systems.	L3: Applying		
CO3	:	Analyse the load calculations and provide appropriate earthing provision.	L4: Analysing		
CO4	:	Prepare a detailed estimate and costing.	L5: Evaluating		
CO5	:	Differentiate the various electrical installation.	L2: Understanding		

<b>23PTEEE63</b>			SEM	EST	ER	VIII
PREREQUI	SITES CATEGORY	Y	PE	Cre	edit	3
Power Systen	n Hours / Wee	-k –	L	Т	P	TH
•			3	0	0	3
Course Obje						
-	art knowledge on energy management systems.					
	erstand network analysis function of EMS.					
	y the function and control of SCADA.					
	yze the concept of SCADA hardware and software.					
5. To study	y the concept of power system automation using SCADA.					
UNIT I	ENERGY MANAGEMENT SYSTEM		9	0	0	9
Introduction		of	9 SCAI			nctio
and Benefits Introduction, Application: C	of EMS, EMS Architecture, Practical EMS, Working of EMS, Static Security Assessment, Operating states of Power System. Control Function, Protection Function, Operating States of Power System		•			curity Onlin
UNIT II	NETWORK ANALYSIS FUNCTION OF EMS		9	0	0	9
			-	v	v	-
	nction, Extended Real Time Function, State Estimation: Introduction, Convent					
	on. Economic Dispatch and Optimal Power Flow: Introduction, Economic	Dispa	atch,	Gener	ration	Mo
Economic c Di	ispatch Problem, Optimal Power Flow problem Formulation.					
	SCADA		0	0	0	0
	SCADA		9	0	0	9
Introduction	to SCADA, Evolution of SCADA, Benefits of S	CAD	A,	Fun	ction	0
Introduction SCADA, SC	to SCADA, Evolution of SCADA, Benefits of S ADA in Process control, SCADA Application, Usage of SCADA	., R	A, leal-Ti	Fun	ction	C
Introduction SCADA, SC	to SCADA, Evolution of SCADA, Benefits of S	., R	A, leal-Ti	Fun	ction	0
Introduction SCADA, SC and Control us	to SCADA, Evolution of SCADA, Benefits of S ADA in Process control, SCADA Application, Usage of SCADA ing SCADA, Data Acquisition, Data Communication, Data Presentation, and Co	., R	A, Real-Ti	Fund me	ction Moni	o itorin
Introduction SCADA, SC and Control us UNIT IV	to SCADA, Evolution of SCADA, Benefits of S ADA in Process control, SCADA Application, Usage of SCADA ing SCADA, Data Acquisition, Data Communication, Data Presentation, and Co SCADA HARDWARE AND SOFTWARE	, R ontrol.	A, ceal-Ti <b>9</b>	Fund me	ction	o itorin 9
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2.	E. Handschin, "Real Time Control of Electric Power Systems", Elsevier, 1972.
E-Ref	erence:
1	NPTEL Online Courses, Energy Management Systems and SCADA, IIT Madras. Link :
1.	"https://nptel.ac.in/courses/108106022/12"

Cours	Course Outcomes:				
Upon	Upon completion of this course, the students will be able to:				
CO1	:	L2: Understanding			
CO2	:	Understand the real time function of EMS.	L1: Remembering		
CO3	:	Explain the real time monitoring and control of SCADA.	L4: Analyzing		
CO4	:	Analyze the hardware and software functions of SCADA.	L4: Analyzing		
CO5	:	Outline the power system automation and protection using SCADA.	L2: Understanding		

231	PTEEE	TEEE64         DIGITAL PROTECTION OF ELECTRICAL SYSTEM			SEM	EST	ER	VIII	
PR	EREQU	ISI	res	CATEGORY	PE	Cre	edit	3	
Dig	ital Sigr	al P	rocessing	Hours / Week	L T		Р	P TH	
	-			nours / week	3	0	0	3	
	Course Objectives:								
			he basic concepts of numerical relaying principles, the	mathematical me	thods	invol	ved a	nd its	
imp	lementa	tion	for equipment protection.						
UI	NIT I		EMENTS OF DIGITAL PROTECTION AND ARG NUMERICAL RELAY	CHITECTURE	9	0	0	9	
			igital Relay - Signal Conditioning Sub systems - Conversion						
			ypes - Quantization error – Sampling – Anti Aliasing Filter – I	Digital Relay sub-sy	/stem -	Func	tional	Block	
Diag	gram of I	lume	rical Relay						
		SI	NUSOIDAL WAVE BASED ALGORITHM, FO	LIDIED AND					
UN	II TI		ALSO BAL WAVE DASED ALGORITHM, FC	UNIER AND	9	0	0	9	
			lerivative method - First and Second-derivative method - Two	sample technique -	Three	samp	le tec	hnique	
- Fu	ll cycle, i	fracti	onal cycle, Fourier transform and Walsh based algorithms						
	IT III	TE	CAST SQUARE AND DIFFERENTIAL EQUATION CONTINUES		9	0	0	9	
			Power series LSQ fit - multi-variable series LSQ technique	e - Differential equ	ation p	protec	tion -	Basic	
Prin	ciples - S	imu	taneous DE Techniques						
TINI	IT IV	ы	CITAL DIFFEDENTIAL BROTECTION OF TRAN	SEODMEDS	9	0	0	9	
			GITAL DIFFERENTIAL PROTECTION OF TRAN sformer protection - FIR based algorithms - LSQ curve fitting			~	-		
			rrent differential relay - Basic hardware requirements.	argoriums - roun	ci base	u aigu	JIIIII	15 -	
UN	IT V	DI	GITAL LINE DIFFERENTIAL PROTECTION		9	0	0	9	
Intro	oduction	- Cu	rrent based differential schemes - Principles - Frequency mod	ulation - Modal cur	rent - j	protec	tion s	cheme	
- Co	mposite	volta	ge and current based scheme						
				Total (45	5L + 0	<b>T</b> ) =	45 Pe	eriods	
Tex	t Books	:							
1.	Johns a	nd S	alman, "Digital Protection for Power Systems", Peter Peregrin	us Ltd. UK, 1995.					
2.	S.R. Bh	ide,	"Digital Power System Protection", PHI Pvt. Ltd. Delhi 2014.						
3.	Power	Syste	m Protection. Vol.4: Digital Protection and Signalling, Institu	tion of Engineering	and T	echno	logy,	1994.	
4.	Vladim	ir Gu	rrevich, "Digital Protective Relays - Problems and Solutions",	CRC Press, 2011.					

Cours	se	<b>Bloom's Taxonomy</b>				
Upon	Upon completion of this course, the students will be able to:					
CO1	:	Understand the basic concepts of digital protection and numerical relay.	L2: Understanding			
CO2	:	Appreciate various mathematical techniques in digital protection	L1: Remembering			
CO3	:	Understand how mathematical techniques are applied for digital protection	L2: Understanding			
CO4	:	Understand the implementation of techniques for Transformer and Line protection	L2: Understanding			
CO5	:	Able to select appropriate hardware required for the digital protection.	L3: Applying			

23P I	TEEE6	5				1	RACTI	ION ENGIN	EERING		SEN	IES	TE	R	VIII
PRE	REQU	ISI	TE	5						CATEGORY	<b>PE</b>	С	red	lit	3
Powe	r Electr	onic	s F	lectric	al Mac	hines	nines Hours / Wee		L	Т	. ]	P	TH		
TOWC	1 Electri	ome	.s, L			,iiiics				nours / wee	× 3	0	)	0	3
Cour	rse Obj	jecti	ives	:											
1	To lea	rn th	he fu	ından	entals	of elec	ctric tract	tion, power sub	bstation, distri	ibution system an	l overhea	d cor	ntact	t sys	tem
1.	design	, coi	nstr	uction	and op	peratio	n								
2.	To lea	rn th	he tr	actior	mecha	anics, J	power su	pply systems a	and role of ba	ttery banks and m	aintenanc	e			
3.	To lea	rn th	he tr	actior	motor	drives	s and con	ntrol							
4.	To lea	rn al	ıbou	t tract	ion pov	ver sur	pply and	protection							
5.	To lea	rn al	bou	railw	ay sigr	nalling	r								
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UNI	ΓV RAILW	AY SIGNALING	9	0	0	9
Block	Section Concept,	AC/DC Track Circuits, Interlocking Principle, Train speed and signalin	g, Solid	state	Interl	ocking,
Autor	natic Warning Sy	stems, CAB signaling, Signaling level crossing. Permissible limit of El	MI and	EMC	, Perr	nissible
capac	itively-coupled cu	rrent, Coupling between circuits, conductive coupling, Electrostatic induc	ction.			
		Total (	45L + (	<b>0T)</b> =	= 45 P	<b>eriods</b>
Refe	rence Books:					
1.	E. A. Binney, "E	lectric Traction Engineering: An Introduction", Cleaver-Hume Press, 195	55, 1 Oc	et 200	7	
2.	Douglas W. Hind	le and M. Hinde, "Electric Traction Systems and Equipment", Elsevier Sc	ience &	Tech	nolog	y, 1968
3.	Samuel Sheldon	and Erich Hausmann, "Electric Traction and Transmission Engineering",	Van N	ostrar	nd, 19	11
4.	Frederick William	m Carter, "Railway Electric Traction", E. Arnold & Company, 1922				
5.	Edward Parris B	urch, "Electric traction for railway trains; a book for students, electrical	and me	chani	cal en	gineers,
5.	superintendents of	of motive power and others", New York, McGraw-Hill Book Company				
6.	Edward Trevert,	"Electric Railway Engineering", Lynn, Mass. :Bubier Pub. Co.				
7.	Burch Edward	Parris, "Electric Traction for Railway Trains; a Book for Students, I	Electrica	ıl and	l Mec	hanical
7.	Engineers, Super	intendents of Motive Power and Others", Arkose Press, ISBN: 97813455	582376,	9781	34558	2376

Cours	Course Outcomes:						
Upon	Upon completion of this course, the students will be able to:						
CO1	:	Understand the basics of traction and supply systems.	L2: Understanding				
CO2	:	Understand the traction mechanics and ideal choice of supply systems.	L4: Analyzing				
CO3	:	Describe the concepts of traction motors and applying the solid-state drive control.	L3: Applying				
CO4	:	Design the protection system for the traction power supply system	L5: Evaluating				
CO5	:	Understand the concepts of railway signaling	L2: Understanding				

23PTEF	E71 ELECTRIC VEHICLES AND CONTROL	OL	SEN	<b>IES</b> T	rer	VIII
PRERE	QUISITES	CATEGORY	PE	Cr	edit	3
Electrical	Drives and Control	Hours / Week	L 3	Т 0	P 0	<u>TH</u> 3
Course	Dbjectives:			Ŭ	Ŭ	
	rovide knowledge on electric vehicle architecture and its configurati	ons				
2. To i	npart knowledge on vehicle control, use of energy storage systems a	and energy manage	ement i	n Eleo	etric V	ehicle
UNIT I	ELECTRIC VEHICLES		9	0	0	9
-	tions of Electric Vehicles (EV), Performance of Electric Vehicles, T ion, Hybrid Electric Vehicles (HEV): Classification, Series Hybrid E ns				-	
UNIT II	PLUG-IN HYBRID ELECTRIC VEHICLES (PHEV CELL ELECTRIC VEHICLES	) AND FUEL	9	0	0	9
	and Benefits of PHEV, Components of PHEVs, Operating Principle Fuel Cell: Operation and Types, Fuel Cell Electric Vehicle: Configu				ontrol	Strategy
UNIT II	ELECTRIC PROPULSION SYSTEMS		9	0	0	9
	ectric propulsion system, Classification of electric motor drives f	or EV and HEV	-	Ŷ	Ű	
UNIT IN Status of	Battery Systems for Automotive Applications, Battery Technologie		•			•
	Polymer (Li–P) Battery, Lithium-Ion (Li-Ion) Battery, Ultracapac Speed Flywheels, Hybridization of Energy Storages	itors: Features, oj		n and	perfo	rmance.
UNIT V	ENERGY MANAGEMENT SYSTEM		9	0	0	9
Fuzzy log Metaheur	anagement System (EMS) in Electric Vehicle, Rule-based contro ic-based control, and Neural network-based control. Optimization ba stic optimization methods and Model predictive control, Semi-activ y active type Hybrid Energy Storage System-based EMS	used control strateg	y: Dyr	amic	Progra	mming,
		Total (	45L +	<b>OT</b> )	= 45 I	<b>eriods</b>
Text Bo	ks:					
	Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", Con, 2011.	CRC Press, Taylor	& Fra	ncis (	Group,	Second
2 Meh	rdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Mod cles", CRC Press, 2016.	lern Electric, Hyb	rid Ele	ctric,	and F	iel Cell
	e Books:					
	Emadi, Mehrdad Ehsani and John M.Miller, "Vehicular Electric Pow on, Marcel dekker, Inc 2010.	wer Systems", Joh	n M.M	iller,	Specia	l Indian
E-Refer						
	://archive.nptel.ac.in/courses/108/106/108106170/					
	-					

Cours	e O	Bloom's Taxonomy	
Upon c	Upon completion of this course, the students will be able to:		
CO1	:	Recall the fundamentals of electric vehicle and its mechanics	L1: Remembering
CO2	:	Explain the architecture of different forms of hybrid electric vehicles.	L2: Understanding
CO3	:	Illustrate the four-quadrant operation of DC drive, induction motor drive and SRM drive for Electric Vehicles.	L4: Analyzing
CO4	:	Select an appropriate energy storage system for Electric vehicle	L4: Analyzing
CO5	CO5 : Use the suitable energy management control strategy for hybrid electric vehicle		L3: Applying

	ГЕЕЕ72	TESTING OF ELECTRIC VEHICLES		SEM	IEST	ER	VIII
PRE	REQUIS	ITES CAT	EGORY	PE	Cre	edit	3
Elect	trical Mac	hines and Power Electronics Hour	rs / Week	L 3	T 0	P 0	TH 3
Cou	rse Objec	tives:		3	U	U	3
1.	_	w various standardization procedures					
2.		n the testing procedures for EV & HEV components					
3.		w the functional safety and EMC					
4.		ize the effect of EMC in EVs					
5.		y the effect of EMI in motor drives and in DC-DC converter system					
UNI	TI E	V STANDARDIZATION		9	0	0	9
Bodie	es Active	urrent status of standardization of electric vehicles, electric Vehicles in the Field – Standardization activities in countries like Japan. tandardization of Vehicle Components.					
UNI		ESTING OF ELECTRIC MOTORS AND CONTROLLEI LECTRIC AND HYBRID ELECTRIC VEHICLES	RS FOR	9	0	0	9
Test I	Procedure	Jsing M-G Set, electric motor, controller, application of Test Procedu	ire, Analysis	of Tes	t Items	for th	е Туре
Test -	– Motor Te	st and Controller Test (Controller Only) Test Procedure Using Edd	ly Current T	ype Eng	gine D	ynam	ometer,
Test 3	Strategy, T	est Procedure, Discussion on Test Procedure. Test Procedure Using .	AC Dyname	meter.			
UNI	T III F	UNDAMENTALS OF FUNCTIONAL SAFETY AND EM	С	9	0	0	9
Func	tional safet	y life cycle- Fault tree analysis - Hazard and risk assessment - soft	tware develo	opment	- Proc	cess n	odels -
Deve	elopment a	ssessments - Configuration management - Reliability - Reliabilit	ty block dia	agrams	and 1	edund	lancy -
Funct	tional safet	y and EMC - Functional safety and quality - Standards - Functional s	safety of aut	onomo	us veh	icles.	
UNI	T IV E	MC IN ELECTRIC VEHICLES		9	0	0	9
Intro	duction - E	MC Problems of EVs, EMC Problems of Motor Drive, EMC Probler	ns of DC-D	C Conv	erter S	Systen	n, EMC
Probl	lems of W	relace Changing Systems EMC Droklam of Vakiala Controllar EN	IC Drohlam			-	
	em, Vehicle	reless Charging System, EMC Problem of Vehicle Controller, EM	IC FIODIein	s of Ba	attery	Mana	
Syste		EMC Requirements.		s of Ba	attery	Mana	
Syste				s of Ba	attery	Mana	
Syste				s of Ba	attery 0	Mana	
UNI	TV E	EMC Requirements.	TEM	9	0	0	gement 9
UNI' Over	<b>T V E</b> view -EMI	EMC Requirements.  MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS	<b>TEM</b> otor Drive S	<b>9</b> ystem,	0 IGBT	0 EMI	gemen 9 Source
UNI Over EMI	<b>T V E</b> view -EMI Coupling	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M	<b>TEM</b> otor Drive S onverter, EM	<b>9</b> ystem, II Sour	0 IGBT	0 EMI	gement 9 Source
UNI Over EMI	<b>T V E</b> view -EMI Coupling	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co	<b>TEM</b> otor Drive S onverter, EM	<b>9</b> ystem, II Sour	0 IGBT	0 EMI	gement 9 Source
UNI Over EMI	<b>T V E</b> view -EMI Coupling	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co	<b>TEM</b> otor Drive S onverter, EM	<b>9</b> ystem, II Sour	0 IGBT ce, Th	0 EMI ie Coi	gement 9 Source nducted
UNI Over EMI	<b>T V E</b> view -EMI Coupling	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co	<b>TEM</b> otor Drive S onverter, EM pupling Path	<b>9</b> ystem, II Sour	0 IGBT ce, Th	0 EMI ie Coi	gement 9 Source. nducted
UNI Over EMI Emis	TV E view -EMI Coupling sion High-	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M. Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co Frequency, Equivalent Circuit of DC-DC Converter System, EMI Co	<b>TEM</b> otor Drive S onverter, EM pupling Path	<b>9</b> ystem, II Sour	0 IGBT ce, Th	0 EMI ie Coi	gement 9 Source. nducted
UNI Over EMI Emis	TV E view -EMI Coupling sion High-	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M. Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co Frequency, Equivalent Circuit of DC-DC Converter System, EMI Co	TEM otor Drive S onverter, EM oupling Path Total (4	<b>9</b> ystem, II Sour <b>45L</b> +	0 IGBT ce, Th 0T) =	0 EMI te Con	9 Source nducted
UNI Over EMI Emis	TV E view -EMI Coupling sion High- erence Bo Ali Ema 2005.	EMC Requirements. <b>MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS</b> Mechanism of Motor Drive System, Conducted Emission Test of M Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co Frequency, Equivalent Circuit of DC-DC Converter System, EMI Co <b>bks:</b>	TEM otor Drive S onverter, EM Dupling Path Total ( ives", Taylo	<b>9</b> ystem, II Sour <b>45L</b> + or & F	0 IGBT ce, Th 0T) =	0 EMI te Con	9 Source nducted
UNI Over EMI Emis Refe	TVE View -EMI Coupling sion High- erence Bo Ali Ema 2005. Li Zhai,	EMC Requirements.  MI IN MOTOR DRIVE AND DC-DC CONVERTER SYS Mechanism of Motor Drive System, Conducted Emission Test of M Path, EMI Modelling of Motor Drive System. EMI in DC-DC Co Frequency, Equivalent Circuit of DC-DC Converter System, EMI Co bks: di, "Handbook of Automotive Power Electronics and Motor Drive	TEM otor Drive S onverter, EM oupling Path Total ( ives", Taylo dition, 2021.	<b>9</b> ystem, II Sour <b>45L</b> + or & F	0 IGBT ce, Th 0T) =	0 EMI te Con	9 Source nducted

5.	Mark Steffika, "Automotive EMC", Springer, 1st Edition, 2013.
6	Beate Müller, and Gereon Meyer, "Electric Vehicle Systems Architecture and Standardization Needs, Reports of the
0.	PPP European Green Vehicles Initiative", Springer, 1st Edition, 2015.

Cour	Course Outcomes:						
Upon	Upon completion of this course, the students will be able to:						
CO1	:	To describe the status and other details of standardization of EVs	L1: Remembering				
CO2	:	To illustrate the testing protocols for EVs and HEV components	L2: Understanding				
CO3	:	To analyze the safety cycle and need for functions safety for EV	L4: Analyzing				
CO4	:	To analyze the problems related with EMC for EV components.	L4: Analyzing				
CO5	:	To evaluate the EMI in motor drive and DC-DC converter system.	L5: Evaluating				

<b>23PTEEE</b>	73 HYBRID ELECTRIC VEHICLES	5	SEM	[EST]	ER	VIII
PREREQ	UISITES	CATEGORY	PE	Cre	dit	3
Electric Dri	ves, Electric Vehicles	Hours / Week	L	Т	Р	TH
		Hours / Week	3	0	0	3
Course O	ojectives:					
1. This	course introduces the fundamental concepts, principles and analysi	s of hybrid and elect	ric veh	icles.		
UNIT I	HISTORY OF HYBRID ELECTRIC VEHICLES		9	0	0	9
	environmental importance of hybrid and electric vehicles, impact			U U		
	hicle performance, vehicle power source characterization, transmis		mather	matica	l moo	lels to
describe vel	ticle performance, Capabilities, Automation system computer facil	ities.				
			0		0	0
UNIT II	HYBRID ELECTRIC VEHICLES - INTRODUCTION d vehicles, mild hybrid vehicles, full hybrid vehicles, Parallel Hybrid		9	0 Vahia	0	9
-	brid vehicles, mild hybrid vehicles, full hybrid vehicles, Parallel Hybrid vehicles, plug-in hybrid vehicles, power flow diagrams for		•			
-	perating principle, architectures: series-parallel-series-parallel, ch			-		-
	ectric Vehicles: Classification and configurations, Fuel Cell Electr	-	-			-
	d their propulsion systems, Vehicle-to- grid, vehicle- to-home con					
UNIT III	ELECTRIC PROPULSION UNIT		9	0	0	9
Electric cor	nponents used in electric vehicles, Configuration and control of	DC Motor drives,	Inducti	on Mo	otor d	lrives,
Permanent l	Magnet Motor drives, Switch Reluctance Motor drives, Drive syste	m efficiency.				
				г. —		
UNIT IV	ELECTRIC DRIVE-TRAINS		9	0	0	9
	pt of electric traction, introduction to various electric drivetrain top	ologies, power flow	control	l in ele	ctric	drive-
train topolo	gies, fuel efficiency analysis					
UNIT V	EV MODELLING AND SIMULATION		9	0	0	9
	of BEV-Forward looking Model-Driver Perspective, Backward	Looking Model-D	-		•	
-	f Driver, Modelling of Brake Control Unit, Modelling of Vehicle Co	-		-	-	
U	omponents- Steady State Energy Balance Equation, Powertrain Dim	0.	0			
-	ve cycles, Types of Control Strategy, Analysis-Performance, Rang	-		1		
		Total (45	$\mathbf{L} + 0$	<b>Γ</b> ) = 4	5 Pe	riods
Text Book	s:					
Gordo	n A. Goodarzi and John G Hayes, "Electric Powertrain: Energy Syst	ems. Power Electror	ics & I	Drives	for H	vbrid.
	c & Fuel Cell Vehicles", Wiley 2018.	,				<i>j</i> ,
2. Wei L	u, "Introduction of Hybrid Vehicle System Modelling and Control	", Wiley student edi	tion 20	13.		
Mehra	dad Eshani, Yimin Gao and Ali Emadi, "Modern Electric,				Vel	nicles,
3. Funda	mentals, Theory and Design", Second Edition, CRC Press, Taylor a	and Francis Group, 2	2010.			
4. James	Larminie and John Lowry, "Electric Vehicle Technology Explaine	d", Second Edition,	Wiley,	2012.		
	nadi, Mehrdad Ehsani and John M. Miller, "Vehicular Electric	Power Systems: La	nd, Sea	, Air,	and	Space
Vehicl	es", CRC Press, 2003.					

6.	Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2 <sup>nd</sup> Edition, 2003.
Ref	erence Books:
1.	RiK De Doncker, "Advanced Electric Drives – Analysis, Modeling, Control", Springer Publications, 2010.
2.	De Doncker, Rik, Pulle, Duco W.J., Veltman, Andre, "Advanced Electrical Drives", First Edition, CRC Press, Taylor and Francis Group, 2011.
3.	Ned Mohan, "Power Electronics Convertor, Applications, and Design", Third Edition, Wiley, 2002.
4.	Iqbal Husain, "Electric and Hybrid Vehicles Design Fundamentals", Second Edition, CRC Press, Taylor and Francis Group, 2011.
5.	Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2002.
6.	Chris Mi, M. Abul Masrur, and David Wenzhong Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley, 2011.
E-R	deferences:
1.	https://nptel.ac.in/courses/108/106/108106170/
2.	https://nptel.ac.in/courses/108/102/108102121/

Cours	Course Outcomes: Bloom's Taxon						
Upon	Upon completion of this course, the students will be able to:						
CO1	:	Plan the selection of electrical machines for hybrid and electric vehicles.	L3: Applying				
CO2	:	Analyze the drive-train topologies and advanced propulsion techniques	L4: Analyzing				
CO3	:	Understand the concepts of electric vehicles, hybrid electric vehicles and their impact on environment	L2: Understanding				
CO4	:	Evaluate modelling and simulation of EV	L5: Evaluating				
CO5	5 : Demonstrate the power system of various vehicular system.		L6: Creating				

23P	TEEE7	4	BATTERY MANAGEMENT SYSTEM	ИS	SEM	IEST	ER	VIII
PRI	EREQU	ISI	ſES	CATEGORY	PE	Cre	edit	3
Basi	cs of E	lectri	cal Engineering, Electric Circuit theory, Chemistry and	TT / TT 1	L	Т	Р	ТН
Phys	sics			Hours / Week	3	0	0	3
Cou	ırse Ob	jecti	ves:					
To u	Inderstan	d dif	ferent techniques of digital relaying - their constructions, wo	rking principles, ap	plicati	ons ar	ıd lim	itations
alon	g with in	trodu	action to Wide Area Measurement System and network protection	ction.				
UN	IT I I	INTI	RODUCTION		9	0	0	9
Intro	oduction	to Ba	attery Management System (BMS), Cells & Batteries, Nomin	nal voltage and cap	bacity,	C rate	, Ene	rgy and
-			nected in series, Cells connected in parallel, Electrochemic		cells,	Recha	argeat	ole cell,
Char	rging and	l Dis	charging Process, Overcharge and Undercharge, Modes of Cl	narging				
					T			
			TERY-MANAGEMENT-SYSTEM REQUIREMEN		9	0	0	9
			BMS functionality, Battery pack topology, BMS Functional	• •	-	-		-
			BMS Functionality, High-voltage contactor control, Isola	tion sensing, The	rmal c	ontro	, Pro	tection,
Com	nmunicat	ion I	nterface, Range estimation, State-of charge estimation.					
-					r			
UN	IT III		TTERY STATE OF CHARGE AND STATE	OF HEALTH	9	0	0	9
			TIMATION					
	•		itions Battery state of charge estimation (SOC)- voltage-ba					
			Battery State of Health Estimation (SOH) - Lithium-ion ag	ing: Negative elec	trode,	Lithiu	m ior	aging:
Posi	tive elect	rode						
TINI	<b>IT 13</b> 7	М	ODELLING AND SIMULATION		9	Δ	Δ	0
	IT IV		ODELLING AND SIMULATION.		-	0	0	9
-			models (ECMs), Physics-based models (PBMs), Empirical ming an electric vehicle, Vehicle range calculations, Simulati		•			-
	ery packs		ing an electric venicie, venicie range calculations, Simulati	ing constant power		onage	, 511	lulating
outt	ny puere	•						
UN	IT V	DF	CSIGN OF BMS		9	0	0	9
			BMS: Design principles of battery BMS, Effect of distance	e load and force		v	v	-
	-	-	with multi-battery system	e, iouu, una ioree	on out	ery n	ie une	. 191110,
	0,	0						
				Total (4	5L + (	<b>(T</b> ) =	45 P	eriods
Tex	t Books	•						
1.			Plett, "Battery Management Systems, Volume I: Battery Mode	eling" Artech Hou	se 201	5		
2.			attery Management Systems: Volume II, Equivalent-Circuit N	-				
			d, W.S. Kruijt and P.H.L. Notten, "Battery Management Syste				lips R	esearch
3	Book S	-						
Ref	erence l	Book	KS:					
1.			rea, "Battery Management Systems for Large Lithium-ion Ba	ttery Packs", Arte	ch Hou	se, 20	10.	
			et al., "Battery Management Systems: Accurate State-o					owered
2.	<sup>2.</sup> Applications", Vol. 9. Springer Science & Business Media, 2008.							

Course Outcomes:			Bloom's Taxonomy	
Upon	con	pletion of this course, the students will be able to:	Mapped	
CO1	:	Recall the role of battery management system	L1: Remembering	
CO2	:	Identify the requirements of Battery Management System w.r.t application	L2: Understanding	
CO3	:	Analyze the concept associated with battery charging / discharging process	L4: Analysing	
CO4	:	Assess the various parameters of battery and battery pack	L3: Applying	
CO5	:	Design the battery pack model.	L4: Analysing	

	EE75		ENIS AND AFFLI		SEM	1		VII
PRERI	REQUISITES CATEGORY			CATEGORY	PE	Credit		3
Electric	ectrical Engineering Hours / Week			Hours / Week	L	T	P	TH
					3	0	0	3
Course	Obje	ctives:						
1. T	'o unde	erstand the various types of energy storage	technologies.					
		yze thermal storage system.						
3. T	'o anal	yze different battery storage technologies.						
4. T	'o mod	el the Lithium-ion batteries.						
5. T	o stud	y the various applications of energy storag	e systems.					
	-						0	
UNIT I		INTRODUCTION hergy storage – Types of energy storage – G			9	0	0	9
UNIT I		THERMAL STORAGE SYSTEM			9	0	0	9
Thermal	l storag	e – Types – Modeling of thermal storage u	units – Simple water a	and rock bed storag	ge syste	em –		
	-	ter storage system – Modeling of phase ch	-	-	•		age un	its –
		ter storage system into deming of pridse en		– Simple units, dac	кеп ре			100
Modelin	g using	porous medium approach – Use of TRNS		- Simple units, pac	keu be	u 3101	C	
Modelin	ig using	g porous medium approach – Use of TRNS		- simple units, pac				
		g porous medium approach – Use of TRNS	SYS.	- Simple units, pac	<b>9</b>	0	0	9
UNIT I	III		SYS.		9	0	0	-
<b>UNIT I</b> Fundame density,	III ental c and sa	ELECTRICAL ENERGY STORAG concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid	SYS. EE performance, chargin d, Nickel – Cadmium,	ng and dischargin	<b>9</b> g, pow	<b>0</b> ver de	0 ensity,	energ
<b>UNIT I</b> Fundame density,	III ental c and sa	ELECTRICAL ENERGY STORAG	SYS. EE performance, chargin d, Nickel – Cadmium,	ng and dischargin	<b>9</b> g, pow	<b>0</b> ver de	0 ensity,	energ
<b>UNIT I</b> Fundam density, Mathem	ental c and sa atical 1	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid modeling of Lead Acid batteries – Flow ba	SYS. E performance, chargin d, Nickel – Cadmium, tteries.	ng and dischargin	<b>9</b> g, pow	<b>0</b> ver de	0 ensity,	energy teries
UNIT I Fundamo density, Mathem UNIT I	ental c and sa atical 1	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid nodeling of Lead Acid batteries – Flow ba	SYS. EE performance, chargin d, Nickel – Cadmium, tteries. LING	ng and dischargin , Zinc Manganese	9 g, pow dioxide 9	0 ver de e, Li-i	0 ensity, ion bat	energ
UNIT I Fundame density, Mathem UNIT I Analysis	III ental c and sa atical 1 IV	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid modeling of Lead Acid batteries – Flow ba	SYS. <b>E</b> performance, chargin d, Nickel – Cadmium, tteries. <b>LING</b> stics of Lithium-ion ba	ng and dischargin , Zinc Manganese atteries – Electroth	9 g, pow dioxide 9 ermal o	0 ver de e, Li-i	0 ensity, ion bat	energ teries
UNIT I Fundam density, Mathem UNIT I Analysis	ental c and sa atical 1 IV	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid modeling of Lead Acid batteries – Flow ba LITHIUM-ION BATTERY MODE arge and discharge temperature characterist odeling and Optimization of Air Cooling H	SYS. <b>E</b> performance, chargin d, Nickel – Cadmium, tteries. <b>LING</b> stics of Lithium-ion ba- eat Dissipation of Lith	ng and dischargin , Zinc Manganese atteries – Electroth hium-ion Battery I	9 g, pow dioxide 9 ermal o	0 ver de e, Li-i	0 ensity, ion bat	energ teries
UNIT I Fundame density, Mathem UNIT I Analysis Modelin	ental c and sa atical 1 IV	ELECTRICAL ENERGY STORAG concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid modeling of Lead Acid batteries – Flow ba LITHIUM-ION BATTERY MODE arge and discharge temperature characteris	SYS. <b>E</b> performance, chargin d, Nickel – Cadmium, tteries. <b>LING</b> stics of Lithium-ion ba- eat Dissipation of Lith	ng and dischargin , Zinc Manganese atteries – Electroth hium-ion Battery I	9 g, pow dioxide 9 ermal o	0 ver de e, Li-i	0 ensity, ion bat	energ teries
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UNIT I Fundame density, Mathem UNIT I Analysis Modelin UNIT V Flywhee storage - Text Be 1	III ental c and sa aatical 1 IV s on ch ag - Mc V el, Sup - Appl	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid nodeling of Lead Acid batteries – Flow bat LITHIUM-ION BATTERY MODE arge and discharge temperature characterist odeling and Optimization of Air Cooling H ALTERNATE ENERGY STORAGE ercapacitors, Principles and methods – A ications, Pumped hydro storage – Applicat	SYS. E performance, chargin d, Nickel – Cadmium, tteries. LING stics of Lithium-ion ba eat Dissipation of Lith E TECHNOLOGII applications, Compressions.	ng and dischargin , Zinc Manganese atteries – Electroth hium-ion Battery I ES ssed air energy sto Total (4	9 g, pow dioxida 9 ermal o Packs. 9 Drage, 1 <b>15L</b> +	0 ver de e, Li- o coupl 0 Conce 0T) =	0 ensity, ion bat 0 ing 0 ept of = <b>45 P</b>	energ teries 9 Hybri eriod
UNIT I Fundame density, Mathem UNIT I Analysis Modelin UNIT V Flywhee storage - Text Ba 1. Ibr Ed 2. Ru	III ental c and sa atical i IV s on ch ag - Mc V el, Sup - Appl ooks: ahim I ition, 2 -shi Li	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid nodeling of Lead Acid batteries – Flow bat LITHIUM-ION BATTERY MODE arge and discharge temperature characterist odeling and Optimization of Air Cooling H ALTERNATE ENERGY STORAGE ercapacitors, Principles and methods – A ications, Pumped hydro storage – Applicat	SYS. E performance, chargin d, Nickel – Cadmium, tteries. LING stics of Lithium-ion ba teat Dissipation of Lith E TECHNOLOGIN Applications, Compressions. rgy Storage Systems	ng and dischargin , Zinc Manganese atteries – Electroth hium-ion Battery I ES ssed air energy ste Total (4 and Applications"	9 g, pow dioxide 9 ermal o Packs. 9 orage, 1 45L +	0 ver de e, Li-i 0 coupl 0 Conce 0T) = Wile:	0 ensity, ion bat 0 ing 0 ept of = <b>45 P</b>	9 9 Hybri eriod
UNIT I Fundame density, Mathem UNIT I Analysis Modelin UNIT V Flywhee storage - Text Be 1. Ibr Ed 2. Ru pul	III ental c and sa atical i IV s on ch ag - Mc V el, Sup - Appl ooks: ahim I ition, 2 i-shi Li blicatic	ELECTRICAL ENERGY STORAGE concept of batteries – Measuring battery fety issues. Types of batteries – Lead Acid modeling of Lead Acid batteries – Flow batteries – Generated arge and discharge temperature characteries odeling and Optimization of Air Cooling H ALTERNATE ENERGY STORAGE ercapacitors, Principles and methods – A ications, Pumped hydro storage – Applicatteries Dincer and Mark A. Rosen, "Thermal Energies 2021. u, Lei Zhang and Xueliang Sun, "Electroc	SYS. E performance, chargin d, Nickel – Cadmium, tteries. LING stics of Lithium-ion ba eat Dissipation of Lith E TECHNOLOGII spplications, Compressions. rgy Storage Systems hemical Technologies	ng and dischargin , Zinc Manganese atteries – Electroth hium-ion Battery I ES ssed air energy sto Total (4 and Applications" s for Energy Storag	9 g, pow dioxide 9 ermal o Packs. 9 orage, 1 <b>15L</b> +	0 ver de e, Li-i coupl 0 Conce 0T) = Wile: Conve	0 ensity, ion bat 0 ing 0 ept of = 45 P	9 9 Hybri eriod
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2.	F.W. Schmidt and A.J. Willmott, "Thermal Energy Storage and Regeneration", Hemisphere Publishing Corporation, 1st Edition, 1981.
E-R	References:
1	Prof. Subhasish Basu Majumder, "Electrochemical Energy Storage", NPTEL Course,
1.	https://nptel.ac.in/courses/113105102
2	Prof. P.K. Das, "Energy Conservation and Waste Heat Recovery", NPTEL Course,
۷.	https://nptel.ac.in/courses/112105221.

Course Outcomes:			Bloom's Taxonomy
Upon completion of this course, the students will be able to:			Mapped
CO1	:	Understand different types of storage technologies.	L2: Understanding
CO2	:	Model a thermal battery energy storage system	L1: Remembering
CO3	:	Analyze the modeling of Lithium-ion batteries.	L4: Analyzing
CO4	:	Analyze the appropriate storage technologies for different applications.	L3: Applying
CO5	:	Explore the alternate energy storage technologies.	L2: Understanding