

SCHOOL OF ELECTRICAL AND COMMUNICATION B.TECH. DEGREE PROGRAMME ELECTRICAL AND ELECTRONICS ENGINEERING VTR-UGE-2021 REGULATIONS

VISION & MISSION OF THE UNIVERSITY

Vision:

To create, translate and disseminate frontiers of knowledge embedded with creativity and innovation for a positive transformation of emerging society.

Mission:

To nurture excellence in teaching, learning, creativity and research; translate knowledge into practice; foster multidisciplinary research across science, medicine, engineering, technology and humanities; incubate entrepreneurship; instill integrity and honor; inculcate scholarly leadership towards global competence and growth beyond self in a serene, inclusive and free academic environment.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING VISION AND MISSION OF THE DEPARTMENT

Vision:

To provide intellectual curiosity in the field of Electrical and Electronics Engineering that produces skilled interdisciplinary engineers to serve the society.

Mission:

M1	To inculcate knowledge among the students through comprehensive curriculum.
M2	To enrich the academic experience in terms of flexibility, teamwork, design skills, practice and industrial trainings.
M3	To produce competent graduates suitable for a successful career in Industry and Research

B.TECH - ELECTRICAL AND ELECTRONICS ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

On successful completion of graduation, graduates will be able to

PEO1	Design and analyse electrical and electronic systems by applying the knowledge of mathematics and engineering
PEO2	Provide practical solution to multidisciplinary societal problems through innovative ideas
PEO3	Secure positions and continue as valued, creative and proficient employees in a wide variety of fields and industries for a rewarding career

PROGRAMME SPECIFIC OUTCOME (PSOs):

PSO1. Apply fundamental of mathematics, physical sciences and electrical & electronics engineering to analyze and solve complex real world problems.

PSO2. Design, develop and implement electrical, electronics and allied engineering systems to meet the demands of industry and suggest solutions for social needs.

PROGRAMME OUTCOMES (POs):

The Electrical and Electronics Engineering Graduates will be able to:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. 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.

<u>PO4.</u> 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.

<u>PO5.</u> Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

<u>PO6.</u> 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.

<u>PO7.</u> 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

<u>PO9.</u> Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. 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.

PO11. 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 environments.

PO12. 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.

Section Number	Course Category	Minimum Credits Required
7.2.1	Foundation Courses (FC)	56
7.2.2	Programme Core (PC)	58
7.2.3	Programme Elective (PE)	18
7.2.4	Open Elective (OE)	12
7.2.5	Independent Learning (IL)	14
7.2.6	Industry/Higher Institute Learning Interaction (IHL)	2
7.2.7	Professional Proficiency Courses (PPC)	4
	Total	164

Minimum credits required for regular students in various course categories

Minimum credits required for Lateral Entry students in various course categories

Section Number	Course Category	Minimum Credits Required
7.2.1	Foundation Courses (FC)	22
7.2.2	Programme Core (PC)	48
7.2.3	Programme Elective (PE)	18
7.2.4	Open Elective (OE)	12
7.2.5	Independent Learning (IL)	14
7.2.6	Industry/Higher Institute Learning Interaction (IHL)	2
7.2.7	Professional Proficiency Courses (PPC)	4
	Total	120



VTR UGE 2021 - EEE Curriculum

Programme Core (PC) Courses – Regular Students

SI.No **Course Code Course Name** Page No. 1 10211EE101 **Circuits Analysis** 19 **DC Machines & Transformers** 2 10211EE102 21 3 10211EE103 AC Machines 23 4 25 10211EE104 **Digital Electronics** 27 5 10211EE105 Linear Control Systems 6 10211EE106 Measurements and Instrumentation 29 7 10211EE107 Transmission & Distribution 31 33 8 **Power Electronics** 10211EE108 9 35 10211EE109 **Power System Analysis** 10 10211EE110 **Power System Operation & Control** 37 11 10211EE111 **Electrical Machine Design** 39 12 10211EE112 Microprocessor & Microcontroller 41 43 13 10211EE113 **Electronic Circuits** 14 10211EE114 **Linear Integrated Circuits** 45 Protection and Switch Gear 15 10211EE115 47 16 10211EE201 **Electromagnetic Fields** 50 17 10211EE301 **Circuits and Devices Lab** 53 10211EE302 DC Machines & Transformers Lab 54 18 19 56 10211EE303 AC Machines Lab 20 10211EE304 **Control & Instrumentation Lab** 58 21 10211EE305 Microprocessor & Microcontrollers Lab 60 22 10211EE306 Analog and Digital Electronics Lab 62 23 **Power Electronics Lab** 10211EE307 63 24 **Power System Simulation Lab** 10211EE308 65

List of Courses for 58 Credits



VTR UGE 2021 - EEE Curriculum

Programme Core (PC) Courses – Lateral Students

SI.No	Course Code	Course Name	Page No.
1.	10211EE101	Circuits Analysis	19
2.	10211EE104	Digital Electronics	25
3.	10211EE105	Linear Control Systems	27
4.	10211EE107	Transmission and Distribution	31
5.	10211EE108	Power Electronics	33
6.	10211EE109	Power System Analysis	35
7.	10211EE110	Power System Operation and Control	37
8.	10211EE111	Electrical Machine Design	39
9.	10211EE112	Microprocessor and Microcontrollers	41
10.	10211EE113	Electronic Circuits	43
11.	10211EE114	Linear Integrated Circuits	45
12.	10211EE115	Protection and Switch Gear	47
13.	10211EE201	Electromagnetic Fields	50
14.	10211EE301	Circuits and Devices Lab	53
15.	10211EE304	Control and Instrumentation Lab	58
16.	10211EE305	Microprocessor and Microcontrollers Lab	60
17.	10211EE306	Analog and Digital Electronics Lab	62
18.	10211EE307	Power Electronics Lab	63
19.	10211EE308	Power System Simulation Lab	65

List of Courses for 48 Credits

Programme Elective (PE) Courses

List of Courses for 18 Credits

SI No.	Course Code	Lecture Courses	Page No.		
	Power Systems Domain				
1.	10212EE121	Power Quality Engineering	70		
2.	10212EE122	High Voltage Engineering	72		
3.	10212EE123	Advances in Power System	74		
4.	10212EE124	Power Plant Engineering	76		
5.	10212EE125	High Voltage Direct Current Transmission	78		
6.	10212EE126	Load Forecasting and Generation Forecasting	80		
7.	10212EE127	Load Dispatching	82		
8.	10212EE128	Reactive Power Management	84		
9.	10212EE129	Smart Grid	86		
		Power Electronics & Drives Domain			
1.	10212EE130	LED Lighting Technology	88		
2.	10212EE131	Flexible AC Transmission Systems	90		
3.	10212EE132	Modern Power Converters	92		
4.	10212EE133	Automotive Electrical & Electronics Systems	94		
5.	10212EE134	Fundamentals of Electric and Hybrid Vehicles	96		
6.	10212EE135	Special Electrical Machines	98		
7.	10212EE136	Electromagnetic Interference & Compatibility	100		
8.	10212EE137	Solid State Drives	102		
	Embedded Systems Domain				
1.	10212EE138	Principles of Robotics	104		
2.	10212EE139	Embedded Systems	106		
3.	10212EE140	Embedded Control of Electric Drives	108		
4.	10212EE141	VLSI System & Design	110		
5.	10212EE142	Wearable Electronics	112		

	Instrumentation & Control Domain			
1.	10212EE143	Virtual Instrumentation	114	
2.	10212EE144	Digital Control Systems	116	
3.	10212EE145	Introduction to Nonlinear Dynamical Systems	118	
4.	10212EE146	Discrete Time Signal Processing	120	
5.	10212EE147	Signals and Systems	122	
6.	10212EE148	Soft Computing	124	
7.	10212EE149	Bio Medical Instrumentation	126	
8.	10212EE150	Process Automation	128	
		Energy Domain		
1.	10212EE151	Utilization of Electrical Energy	130	
2.	10212EE152	Energy Auditing and Management	132	
3.	10212EE153	Electrical Safety & Safety Management	134	
4.	10212EE154	Renewable Energy Sources	136	
5.	10212EE155	Solar Electric Systems	138	
6.	10212EE156	Wind Energy Conversion Systems	140	
7.	10212EE157	Generation Planning	142	
8.	10212EE158	Solar Photovoltaic Systems	144	
		Electronics Domain		
1.	10212EE159	Nano Electronics	146	
2.	10212EE160	Green Electronics	148	
3.	10212EE161	Automotive Electronics	150	
4.	10212EE162	Vehicle Electronics	152	
5.	10212EE163	Optoelectronic Devices	154	
6.	10212EE164	Electronic Circuit Simulation and PCB Design	156	
7.	10212EE165	Medical Electronics	158	
Integrated Courses				
1.	10212EE201	Applied Soft Computing	160	
2.	10212EE202	Switch Mode Power Supply Design and Development	162	
3.	10212EE203	Electrical Machines (only for lateral entry students)	165	
	Laboratory Course			
1.	10212EE301	Voltage Stabilizer Fabrication	168	

Open Elective Courses

List of Courses for 12 Credits

SI.No	Course Code	Lecture Courses	Page No.
1.	10213EE101	Neural Network and Fuzzy Logic Control	172
2.	10213EE102	Bio Medical Instrumentation	174
3.	10213EE103	Introduction to Automation	176
4.	10213EE104	Virtual Instrumentation	178
5.	10213EE105	Finite Element Analysis	180
6.	10213EE106	EMI & EMC Techniques	182
7.	10213EE107	Power Supply Quality	184
8.	10213EE108	LED Lighting	186
9.	10213EE109	Transducers And Sensors	188
10.	10213EE110	Signals and Systems	190
11.	10213EE111	Wearable Electronics	192
12.	10213EE112	Embedded System	194
13.	10213EE113	Estimation For Electrical Wiring	196
14.	10213EE114	Renewable Energy Systems	198
15.	10213EE115	Automotive Electrical & Electronics Systems	200
16.	10213EE116	Hybrid Electric Vehicles	202
17.	10213EE117	Introduction to Robotics	204
18.	10213EE118	Standards, Calibration, Testing & Maintenance of Electrical Equipments	206
19.	10213EE119	Electrical Safety, Operation & Regulations	208
20.	10213EE120	Energy Conservation and Management	210
21.	10213EE121	Electrical Machines	212
22.	10213EE122	Industrial Electrical Systems	214

SI.No	Course Code	Lecture Courses	Page No.
23.	10213EE123	Computer Aided Analysis of Electrical Apparatus	216
24.	10213EE124	Green Energy Resources	218
25.	10213EE125	Robotics and Automation	220
26.	10213EE126	Wind Energy Technology	222
27.	10213EE127	Electrical Safety and Safety Management	224
		Integrated Courses	
28.	10213EE201	Switch Mode Power Supply design and Development	226
Laboratory Courses			
29.	10213EE301	Voltage Stabilizer Fabrication	229

B.Tech EEE Specialization in Computer Systems

List of Courses for 18 Credits

SI.No	Course Code	Lecture Courses	Page No
1.	10212EE101	Computer Architecture	233
2.	10212EE102	Operating Systems	235
3.	10212EE103	Object Oriented Programming	237
4.	10212EE104	Data Structures and Algorithms	239
5.	10212EE105	Computer Networks and Communication	241
6.	10212EE106	Artificial Intelligence	243

SI.No	Course Code	Lecture Courses	Page No
1.	10213EE131	Charging Station	247
2.	10213EE132	Battery Management System	249
3.	10213EE133	Electric Propulsion System and Control	251
4.	10213EE134	Hybrid Electric Vehicle Technologies	253
5.	10213EE135	Energy Storage Systems and Control	255
6.	10213EE136	Modelling and Simulation of EV	257

Minor Degree in Electric Vehicle Technology List of Courses for 18 Credits

Minor Degree in Renewable Energy Sources List of Courses for 18 Credits

S.No.	Course Code	Lecture Courses	Page No.
1.	10213EE141	Renewable Energy	261
2.	10213EE142	Wind Energy Conversion Systems	263
3.	10213EE143	Solar Photovoltaics: Fundamentals, Technology and Applications	265
4.	10213EE144	Conversion of Energy in Buildings	268
5.	10213EE145	Solar Thermal Energy Systems	270
6.	10213EE146	Distributed Generation and Integration of Renewable Energy with Grid	272

B.Tech. EEE with Honors in Smart Grid Technologies
List of Courses for 18 Credits

Sl.No	Course Code	Lecture Courses	Page No.
1.	10212EE171	Smart Grid	276
2.	10212EE172	Energy Management and SCADA	278
3.	10212EE173	Power System Restructuring	280
4.	10212EE174	Distributed Generation and Micro Grid	282
5.	10212EE175	IoT Applications in Smart Grid	284
6.	10212EE176	AI for Smart Grid Systems	286



VTR UGE 2021 - EEE Curriculum Programme Core (PC) Courses – Regular Students

S.NO.	COURSE CODE	COURSE NAME	L	т	Р	С
		LECTURE COURSES				
1.	10211EE101	Circuits Analysis	3	1	0	4
2.	10211EE102	DC Machines and Transformers	3	0	0	3
3.	10211EE103	AC Machines	3	0	0	3
4.	10211EE104	Digital Electronics	3	0	0	3
5.	10211EE105	Linear Control Systems	2	1	0	3
6.	10211EE106	Measurements and Instrumentation	2	0	0	2
7.	10211EE107	Transmission and Distribution	3	0	0	3
8.	10211EE108	Power Electronics	3	0	0	3
9.	10211EE109	Power System Analysis	3	1	0	4
10.	10211EE110	Power System Operation and Control	3	0	0	3
11.	10211EE111	Electrical Machine Design	3	1	0	4
12.	10211EE112	Microprocessor and Microcontrollers	3	0	0	3
13.	10211EE113	Electronic Circuits	3	0	0	3
14.	10211EE114	Linear Integrated Circuits	3	0	0	3
15.	10211EE115	Protection and Switch Gear	3	0	0	3
		INTEGRATED COURSES				
16.	10211EE201	Electromagnetic Fields	2	0	2	3
		LABORATORY COURSES				
17.	10211EE301	Circuits and Devices Lab	0	0	2	1
18.	10211EE302	DC Machines and Transformers Lab	0	0	2	1
19.	10211EE303	AC Machines Lab	0	0	2	1
20.	10211EE304	Control and Instrumentation Lab	0	0	2	1
21.	10211EE305	Microprocessor and Microcontrollers Lab	0	0	2	1
22.	10211EE306	Analog and Digital Electronics Lab	0	0	2	1
23.	10211EE307	Power Electronics Lab	0	0	2	1
24.	10211EE308	Power System Simulation Lab	0	0	2	1
		TOTAL				58



VTR UGE 2021 - EEE Curriculum

Programme Core (PC) Courses – Lateral Entry students

S.NO.	COURSE CODE	COURSE NAME	L	т	Р	С
		LECTURE COURSES	-	-		-
1.	10211EE101	Circuits Analysis	3	1	0	4
2.	10211EE104	Digital Electronics	3	0	0	3
3.	10211EE105	Linear Control Systems	2	1	0	3
4.	10211EE107	Transmission and Distribution	3	0	0	3
5.	10211EE108	Power Electronics	3	0	0	3
6.	10211EE109	Power System Analysis	3	1	0	4
7.	10211EE110	Power System Operation and Control	3	0	0	3
8.	10211EE111	Electrical Machine Design	3	1	0	4
9.	10211EE112	Microprocessor and Microcontrollers	3	0	0	3
10.	10211EE113	Electronic Circuits	3	0	0	3
11.	10211EE114	Linear Integrated Circuits	3	0	0	3
12.	10211EE115	Protection and Switch Gear	3	0	0	3
		INTEGRATED COURSES				
13.	10211EE201	Electromagnetic Fields	2	0	2	3
		LABORATORY COURSES	-			
14.	10211EE301	Circuits and Devices Lab	0	0	2	1
15.	10211EE304	Control and Instrumentation Lab	0	0	2	1
16.	10211EE305	Microprocessor and Microcontrollers Lab	0	0	2	1
17.	10211EE306	Analog and Digital Electronics Lab	0	0	2	1
18.	10211EE307	Power Electronics Lab	0	0	2	1
19.	10211EE308	Power System Simulation Lab	0	0	2	1
		TOTAL				48

Programme Core

THEORY COURSES

COURSE CODE:	
10211EE101	

COURSE TITLE: CIRCUIT ANALYSIS

L	Т	Р	С
3	1	0	4

COURSE CATEGORY: Programme Core

PREAMBLE: This course aims to develop the necessary fundamentals for Electrical and Electronics engineers to analyze and solve a simple circuit involving DC and AC by making use of network laws and theorems. This course also provides a basic and comprehensive knowledge of circuits involving three phase, resonance, coupled and transients which an electrical engineer will come across in many applications and provide their solution.

PREREQUISITE COURSES: Electronics and Measurement Engineering

RELATED COURSES: Linear Integrated Circuits

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the significance of the basic terminologies in electrical circuits and relation between the electrical quantities of R, L and C.
- Be proficient in handling basic laws and theorems in solving circuits.
- Be familiar with network topology and two port networks.
- Understand coupled and three phase circuits.
- Analyse the effect of transients and resonance.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.				Cou	ırse Ou	itcome	S				Knowle on r	edge Le evised Taxonc	evel (Ba Bloom omy)	ased 's
CO1	Expla AC ci	in the b rcuits	oasic la	ws and	l mesh	and no	odal an	alysis o	of DC ar	nd		К2		
CO2	Apply	y netwo	ork the	orems	for DC	and AC	C circuit	S				К3		
CO3	Build circu	the ne [:] it	twork ۽	graph a	ind net	work p	arame	ters fo	r a give	n		К3		
CO4	Solve	e couple	d and	three p	bhase c	ircuits						КЗ		
CO5	Ident	ify circu	uits inv	olving	transie	nts and	d reson	ance				К3		
CORREI		N OF CO	s WITH	H POs A	AND PS	Os								
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	Н	Н	М	L						L	L	Н	L
CO2	Н	Н	Н	М	L						L	L	Н	L
CO3	Н	Н	Н	М	L						L	L	Н	L
CO4	Н	Н	Н	М	L						L	L	Н	L
CO5	н	Н	Н	М	L						L	L	Н	L

COURSE	CONTENT:	
UNIT I	BASIC CIRCUIT ANALYSIS	12
Review c Laws, Me	f circuit elements – types of electric circuits, types of voltage and current source, Kin esh current and Node voltage analysis for DC and AC circuits, super mesh and super	rchhoff's node
UNIT II	NETWORK THEOREMS	12
Superpos theorem	sition theorem - Thevenin's theorem - Norton's theorem - Maximum power - Reciprocity theorem.	transfer
UNIT III	NETWORK TOPOLOGY AND TWO PORT NETWORKS	12
Network network,	topology, Incidence matrix, Tie-set matrix, Cut-set matrix, Dual networks - T Impedance Parameter, Admittance Parameter, Transmission line.	wo port
UNIT IV	COUPLED AND THREE PHASE CIRCUITS	12
Self and tuned cir wattmet	Mutual inductance - Coefficient of coupling-Analysis of coupled circuits - Analysis cuits, Solution of circuits with balanced and unbalanced loads - Power measuremen er method.	of single It by two
UNIT V	CIRCUIT TRANSIENTS AND RESONANCE	12
Transien quality fa	t response of RL, RC and RLC circuit using Laplace transform, Series and parallel res actor for series and parallel resonance circuit, bandwidth and resonant filters.	sonance,
	TOTAL: 60 F	PERIODS
TEXTBOO	DKS:	
1. \ ר	Villiam H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits A ⁻ ata McGraw Hill publishers, 6 th edition, New Delhi, 2003.	nalysis",
2. J M	oseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McG New Delhi, 2001.	raw-Hill,
REFEREN	ICE BOOKS:	
1. F	Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, 199	96.
2. S	Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthes McGraw Hill, 2007.	is", Tata
3. (1	Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, Ne 1999.	w Delhi,
4. C	Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Edition, McGraw Hill, 2003.	Second
5. <u>k</u>	https://nptel.ac.in/courses/108105159	

COUF	RSE CODE:	COURSE TITLE:	L	Т	Р	С
102	11EE102	DC MACHINES & TRANSFORMERS	3	0	0	3
COURSE	CATEGORY: Pr	rogramme Core		•		
PREAME and mo applicati develops	BLE: This course tors), Transfor ons to engine s problem solvi	e provides an introduction to the basic concepts of E rmers and their testing methods, emphasizing t eering, and research areas; introduce students to ng skills with both theoretical and engineering orien	DC Mae heir i cogn ted pr	chines nter-re itive le oblems	(Gener lations earning	rators and g and
PREREQ	UISITE COURSE	ES: Nil				
RELATED	COURSES: AG	C Machines, Electrical Machine Design				
COURSE The obie	EDUCATIONA ctives of the co	L OBJECTIVES: Durse are to,				
•	Jnderstand th	ne fundamentals of rotating electrical machines.				
•	Provide the bas	sic concept of DC machines and Transformers.				
•	Diagnose the c	ondition of DC machines and Transformers.				
COURSE Upor	OUTCOMES: n the successfu	Il completion of the course, students will be able to:				
CO Nos		Course Outcomes	Lev dom rev	el of le nain (Ba vised Bl taxono	arning ased o oom's my)	s n
CO1	Elaborate conversion.	the principle of electromagnetic energy		К2		
CO2	Explain the p	erformance characteristics of DC Generators.		K2		
CO3	Describe the	performance characteristics of DC Motors.		K2		
CO4	Describe the the testing characteristic	equivalent circuit of transformers and Realize methods to determine the performance cs of Transformers		К2		
COL	Understand	three phase transformer connections and		21		

CORRELATION OF COS WITH POS AND PSOS

parallel operation.

CO5

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н		L			L				L	L	М	L
CO2	Н	Н		М							L	М	Н	L
CO3	Н	Н		М							L	М	Н	L
CO4	Н	Н		М							L	М	Н	L
CO5	Н	Н	L	М							L	М	Н	L

К2

COURSE C	ONTENT:	
UNIT I	BASIC CONCEPTS OF ROTATING MACHINES	9
Principles – Energy distributed	of electromechanical energy conversion – Force and Torque equ and Force in single and multiple excited systems – Concept c windings – Rotating magnetic field –Torque in wound rotor mac	ations in magnetic fields of Co-energy – MMF of hine.
UNIT II	DC GENERATORS	9
Constructi Simplex ar Armature	onal details – Principle of operation – Armature windings – la nd Multiplex windings – emf equation – Methods of excitation – Reaction – Compensating winding – Commutation – methods of i	p and wave windings – Types – Characteristics - mproving Commutation
UNIT III	DC MOTORS	9
Principle of starting of motors (Sv	of operation – Back emf and torque equation – Types - Characted dc motors – Types of starters – Speed control of dc shunt and se vinburne's and Hopkinson's test).	eristics and application – eries motors – Testing of
UNIT IV	SINGLE PHASE TRANSFORMERS	9
Constructi - Paramet Losses and Sumpner's	on- Principle of operation - emf equation- Transformation ratio - ers referred to HV/LV windings - Equivalent circuit - Transform d efficiency of transformers - testing of transformers: open circuit test.	Transformer on no-load er on load- Regulation - it and short circuit tests,
UNIT V	THREE PHASE TRANSFORMERS	9
Constructi connection Transform Cooling of	on, types of connection and their comparative features, Scott n, tertiary winding, Parallel operation of three-phase transfo er. Tap changing transformers – No load and on load tap ch transformers - All day efficiency. Autotransformers - Saving of co	connection, open delta rmers, Load Sharing of anging of transformers, pper, applications.
		TOTAL: 45 PERIODS
TEXTBOO	<s:< td=""><th></th></s:<>	
1. A. Pu	E.Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Mach blishing Company Ltd, 2003.	inery" Tata McGraw Hill
2. Dr	.P.S.Bimbhra, "Electrical Machinery", Khanna Publishers, 7 th Edisc	on, 2013
REFERENC	E BOOKS:	
1. P. Ed	C. Sen, "Principles of Electric Machines and Power Electronics" J ison, 1996.	ohn Wiley and Sons, 2 nd
2. D.		
20	P.Kothari and I.J.Nagrath, "Electric Machines", Tata McGraw Hill 02.	Publishing Company Ltd,

	URSE CODE:	COURSE T	ITI F:	L	Т	Р	(
10	0211EE103	AC MACH	INES	3	0	0	
OURSE	CATEGORY: Prog	ramme Core					
REAME pecial I rinciple	BLE: The course p Machines, which r e, control techniqu	rovides knowledge on vari nould the students in relations.	ous types of AC Gener tion to the performanc	ator, A e char	AC Mot acterist	or and ics, ope	rece erat
REREQ	UISITE COURSES:	DC Machines & Transforme	ers				
ELATEI	D COURSES: Elect	rical Machine Design, Solid	State Drives				
OURSE	EDUCATIONAL O	BJECTIVES:					
ne obje	ectives of the cour	se are to,					
•	Analyse the perfor	mance characteristics of Sy	nchronous machines				
•	Explain the perfor	mance characteristics of ind	duction machines.				
•	Summarize the co	heept of single-r hase induc		ii iviaci	intes.		
OURSE Upo	OUTCOMES: In the successful co	ompletion of the course, sto	udents will be able to:				
OURSE Upo CO No.	e OUTCOMES: In the successful co	ompletion of the course, sto Course Outcomes	udents will be able to:	d	Level of lomain revised taxo	f learnii (Based Bloom nomy)	ng on 's
OURSE Upo CO No.	E OUTCOMES: on the successful co Explain the co regulation of the	ompletion of the course, sto Course Outcomes operating principle, met ree phase alternator	udents will be able to: hods of determining	d	Level of lomain revised taxo	f learnii (Based Bloom nomy) K2	ng on 's
OURSE Upo CO No. CO1 CO2	E OUTCOMES: on the successful co Explain the of regulation of the Analyse the cha	ompletion of the course, sto Course Outcomes operating principle, met ree phase alternator racteristics of synchronous	udents will be able to: hods of determining	d	Level of lomain revised taxo	f learnii (Based Bloom nomy) K2 K4	ng on 's
OURSE Upo CO No. CO1 CO2 CO3	EXPlain the char control of the successful control of the successful control of the control of the char co	Course Outcomes Course Outcomes operating principle, met ree phase alternator racteristics of synchronous rformance characteristics	udents will be able to: hods of determining motors of 3 phase Induction	d 3 1	Level of lomain revised taxo	f learnii (Based Bloom nomy) K2 K4	ng on 's
OURSE Upo CO No. CO1 CO2 CO3 CO4	EXPlain the constraint of the successful constraint of the successful constraint of the constraint of	Course Outcomes Course Outcomes operating principle, met ree phase alternator racteristics of synchronous rformance characteristics trol strategies of 3 phase In	udents will be able to: hods of determining motors of 3 phase Induction	d	Level of lomain revised taxo	f learnii (Based Bloom nomy) K2 K4 K2 K4	ng on 's

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н		L		L						L	Н	L
CO2	Н	Н		М									Н	L
CO3	Н	Н	М	М			L						Н	L
CO4	Н	Н		М									Н	L
CO5	Н	М		М		М						L	Н	L
		•	•	•	•		•	•			•		•	•

COURSE CONTEN	IT:	
UNIT I	SYNCHRONOUS GENERATOR	9
Constructional de Voltage regulati Synchronizing to Determination of	etails – Types of rotors – emf equation – Synchronous reactance – Arm on – EMF, MMF and ZPF methods – Synchronizing and parall orque - Change of excitation and mechanical input – Two reac direct and quadrature axis synchronous reactance using slip test - Capa	ature reaction – el operation – ction theory – ability curves.
UNIT II	SYNCHRONOUS MOTOR	9
Principle of oper power develope excitation and co	ation – Torque equation – infinite bus – V and inverted V curves – P d equations – Starting methods – Current loci for constant power nstant power developed.	ower input and input, constant
UNIT III	THREE PHASE INDUCTION MOTOR	9
Rotating magnet Equivalent circuit Load test - No lo cage rotors – Ind	cic field-Constructional details – Types of rotors – Principle of ope – Slip-torque characteristics - Condition for maximum torque – Losses ad and blocked rotor tests - Circle diagram – Separation of no-load uction generator – Synchronous induction motor.	ration – Slip – and efficiency – losses – Double
UNIT IV	STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	9
Need for starting Speed control – power recovery s	g – Types of starters –DOL, star-delta, autotransformer and rotor resis Change of voltage, frequency, number of poles and slip – Cascaded co scheme.	tance starters – onnection – Slip
UNIT V	SINGLE PHASE INDUCTION MOTORS	9
Constructional de Equivalent circuit phase induction motor and AC se	etails of single-phase induction motor – Double revolving field theory a – No load and blocked rotor test – Performance analysis – Starting me motors - Shaded pole induction motor, reluctance motor, repulsion m ries motor.	and operation – thods of single- otor, hysteresis
	тот	AL: 45 PERIODS
TEXTBOOKS:		
1. Dr. P.S. B	himbra, 'Electrical Machinery', Khanna Publications, 7 th Edition, 2007	
2. D.P. Koth 2010	ari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Co	mpany Ltd,
REFERENCE BOO	KS:	
1. A.E. Fitzg Publishin	erald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata M g Company Ltd, 2002.	cGraw Hill
2. B. L. The 2002.	raja and A.K. Theraja, " A Text Book of Electrical Technology", S. Cha	and Publication,
3. K. Murug	esh Kumar, "Electric Machines", Vikas Publishing House Pvt Ltd, 2004.	
4. P.S. Bhim	bhra, "Electrical Machinery", Khanna Publishers, 2003.	
5. <u>https://n</u>	ptel.ac.in/courses/108105131	

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10211EE104	DIGITAL ELECTRONICS	3	0	0	3
COURSE CATEGORY: Pr	ogramme Core				

PREAMBLE: The primary aim of this course is to understand the fundamentals of digital logic circuit design and gain experience. This course includes fundamentals of Boolean algebra, combinational circuits, sequential circuits and applications of digital electronics.

PREREQUISITE COURSES: Basic Electronics and Measurement Engineering

RELATED COURSES: Microprocessor and Microcontroller

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Familiar with number systems and Boolean algebra.
- Understand and explain sequential digital logic circuits.
- Design and implement combination logic circuits.
- Study the applications of digital electronics.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of digital electronics.	К2
CO2	Develop combinational logic circuits for the given logical expressions.	К4
CO3	Understand the basic concepts of Flip-flops, Registers and Counters.	К2
CO4	Develop synchronous and asynchronous sequential circuits.	К4
CO5	Explain the applications of digital electronics.	К2

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Н	Н		М								М	Н	М
Н	Н	Н	Н								М	Н	М
Н	Н	Н	Н								М	Н	М
Н	Н	Н	Н								М	Н	М
М	L				М						L	L	L
	PO1 H H H M	PO1 PO2 H H H H H H H H H H H H H H H H H H H H	PO1 PO2 PO3 H H H H H H H H H H H H H H H H H H H H H H H H H H H	PO1 PO2 PO3 PO4 H H M M H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H	PO1 PO2 PO3 PO4 PO5 H H M M I H H H H I H H H H I H H H H I H H H I I H H H I I H H H I I H H I I I	PO1 PO2 PO3 PO4 PO5 PO6 H H M M I I H H H H I I H H H H I I H H H H I I H H H H I I H H H I I I H H H I I I H H H I I I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 H H M M I I I H H H I I I I H H H I I I I H H H I I I I H H H I I I I H H H I I I I H H H I I I I H H H I I I I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 H H M M I I I I H H H I I I I I H H H I I I I I I H H H I I I I I I I H H H I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 H H M M I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 H H M M I	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11HHMMIIIIIIIIHHHIIIIIIIIIIHHHIIIIIIIIIIHHHIIIIIIIIIIHIIIIIIIIIIIIMIIIIIIIIIIII	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12HHMMIIIIIMMHHHIIIIIIIMHHHIIIIIIIIMHHHIIIIIIIIIIHHIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIII<	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01HHMMIIIIIIIIIHHHIIIIIIIIIIHHHIIIIIIIIIIHHIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIIIIIIIIIIHIIIII

UNIT I DIGITAL FUNDAMENTALS 9 Analog and Digital Signals, introduction to Digital electronics, Number Systems-Types, fundamental binary arithmetic and logic operation, 1's complement and 2's complement, code conversion. Introduction to Boolean algebra-Boolean postulates and laws – De-Morgan's Theorem – Principle of Duality – Boolean expression – Minimization of Boolean expressions. 9 COMBINATIONAL CIRCUITS 9 Combinational logic representation of logic functions – SOP and POS forms, K-map representations – minimization using K-maps - simplification and implementation of combinational logic – multiplexers and demultiplexers – code converters, adders, subtractors. 9 UNIT II SEQUENTIAL LOGIC CIRCUITS 9 SR, JK, D and T flip-flops – level triggering and edge triggering – counters – Pulse forming circuits - asynchronous and synchronous type – Modulo counters – Shift registers – Ring counters. 9 VINT IV SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9 Synchronous sequential circuits: State table and excitation tables - state diagrams, sequential circuit design using Mealy and Moore model, state reduction and state assignment 9 Asynchronous sequential circuits: transition table, flow table – race around conditions, circuits with latches, analysis procedure. 9 UNIT V APPLICATIONS OF DIGITAL ELECTRONICS 9 Multiplexing displays - Frequency counters - Time measurements - using	COURSE	CONTENT:	
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Duality – Boolean expression – Minimization of Boolean expressions. UNIT II COMBINATIONAL CIRCUITS 9 Combinational logic representation of logic functions – SOP and POS forms, K-map representations – minimization using K-maps- simplification and implementation of combinational logic – multiplexers and demultiplexers – code converters, adders, subtractors. 9 UNIT III SEQUENTIAL LOGIC CIRCUITS 9 SR, JK, D and T flip-flops – level triggering and edge triggering – counters – Pulse forming circuits - asynchronous and synchronous type – Modulo counters – Shift registers – Ring counters. 9 UNIT IV SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9 Synchronous sequential circuits: State table and excitation tables - state diagrams, sequential circuit design using Mealy and Moore model, state reduction and state assignment Asynchronous sequential circuits: Transition table, flow table – race around conditions, circuits with latches, analysis procedure. UNIT V APPLICATIONS OF DIGITAL ELECTRONICS 9 Multiplexing displays - Frequency counters - Time measurements - using the ADC0804 - Slope alone operation, span adjust, zero shift, testing - microprocessor compatible A/D converters, FPGA TEXT BOOKS: 1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003. 2. Donald .P.Leach, Digital principles and applications,7th Edition, McGraw-Hill ,2012	Analog a binary a Introduc	nd Digital Signals, introduction to Digital electronics, Number Sy ithmetic and logic operation,1's complement and 2's complement, c tion to Boolean algebra-Boolean postulates and laws – De-Morga	ystems-Types, fundamental ode conversion. n's Theorem – Principle of
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UNIT IV SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS 9 Synchronous sequential circuits: State table and excitation tables - state diagrams, sequential circuit design using Mealy and Moore model, state reduction and state assignment 9 Asynchronous sequential circuits: Transition table, flow table - race around conditions, circuits with latches, analysis procedure. 9 UNIT V APPLICATIONS OF DIGITAL ELECTRONICS 9 Multiplexing displays - Frequency counters - Time measurements - using the ADC0804 - Slope alone operation, span adjust, zero shift, testing - microprocessor compatible A/D converters, FPGA TOTAL: 45 PERIODS TEXT BOOKS: 1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003. 2. Donald .P.Leach, Digital principles and applications,7th Edition, McGraw-Hill ,2012 REFERENCE BOOKS: 1. 1. John F.Wakerly, Digital Design, Fourth Edition, Pearson Education Inc, New Delhi, 2003 Donald D.Givone, Digital Principles and Design, TMH. 3. William H. Gothmann, Digital Electronics, 2nd Edition, PH, 1982. 4. https://onlinecourses.nptel.ac.in/noc22_ee110/preview 4 https://onlinecourses.nptel.ac.in/noc22_ee110/preview	SR, JK, E asynchro	and T flip-flops – level triggering and edge triggering – counters nous and synchronous type – Modulo counters – Shift registers – Ri	s – Pulse forming circuits - ng counters.
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UNIT V APPLICATIONS OF DIGITAL ELECTRONICS 9 Multiplexing displays - Frequency counters - Time measurements - using the ADC0804 - Slope alone operation, span adjust, zero shift, testing - microprocessor compatible A/D converters, FPGA TOTAL: 45 PERIODS TEXT BOOKS: 1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003. 2. Donald .P.Leach, Digital principles and applications,7th Edition, McGraw-Hill ,2012 REFERENCE BOOKS: 1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006. 2. Thomas L. Floyd, Digital Fundamentals, 8th Edition, Pearson Education Inc, New Delhi, 2003 Donald D.Givone, Digital Principles and Design, TMH. 3. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982. 4. https://online.courses.nptel.ac.in/noc22ee110/preview	Synchroi design u Asynchro latches,	nous sequential circuits: State table and excitation tables - state of sing Mealy and Moore model, state reduction and state assignment phous sequential circuits: Transition table, flow table – race aroun analysis procedure.	diagrams, sequential circuit nd conditions, circuits with
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	3. 4.	william H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.	

COURSE CODE:	COURSE TITLE:	L	Т	Р	С		
10211EE105	10211EE105 LINEAR CONTROL SYSTEMS						
COURSE CATEGORY: Prog	ramme Core						

PREAMBLE: This Course aims to provide knowledge in mathematical modelling with state space and transfer function models, time and frequency response analysis and stability studies of the system.

PREREQUISITE COURSES: Circuit Analysis

RELATED COURSES: Digital Control Systems

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Acquire knowledge in mathematical modelling of various systems.
- Perform time and frequency domain analysis and the check the stability.
- Apply controllers and compensators design for the system based on given specifications.
- Develop state space model from transfer function.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Develop mathematical Model for electrical, mechanical and Electro mechanical systems and Obtain transfer function using block diagram algebra and mason's gain formula	К2
CO2	Calculate various time domain specifications and describe their significance	К2
CO3	Analyze the Performance of the given System using frequency response plots and root locus	КЗ
CO4	Determine the stability of the given system using time and frequency domain approach	К3
CO5	Identify suitable compensator based on given specifications and explain the concept of P, PI and PID Controllers	КЗ
CO6	Develop state space models from transfer functions and vice versa	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М		L						L	М	Н	М
CO2	Н	Н	L		М							М	Н	М
CO3	Н	Н	Н	М	М						М	М	Н	М
CO4	Н	Н	М									М	Н	М
CO5	Н	Н	М	М	М						М	М	Н	М
CO6	Н	Н	М								L	М	Н	М

UNIT I	TRANSFER FUNCTION MODEL OF SYSTEMS	9
Introduction to control Transfer Function - Tra Analogies between elec block diagram reductio	systems - open loop and closed loop systems - Mathematical model nsfer function model of electrical, mechanical and electromechanic ctrical and mechanical systems - Block diagram algebra - Transfer fu n and Signal flow graph	of systems al systems nction using
UNIT II	TIME RESPONSE ANALYSIS	9
Poles, zeros, type and second order systems error – Introduction t	d order of system - Standard test signals - Time response of first s - Time response specifications - Static error coefficients and st o P, PI and PID Controllers.	t order and teady state
UNIT III	FREQUENCY RESPONSE ANALYSIS	9
Introduction to frequent Bode plots - Frequency of lag and lead compen	ncy response - Correlation between Time and frequency response - response specifications - Basics of lead, lag and lead-lag compensat sators using Bode plots.	Polar plot - ors - Design
UNIT IV	SYSTEM STABILITY ANALYSIS	9
in time domain: Routh- - Stability analysis in fre	Hurwitz criterion - Root locus concept - rules for constructing root lo equency domain: Nyquist stability criterion - Relative stability analysis	cus diagram
UNIT V	STATE SPACE MODEL OF SYSTEMS	9
UNIT V Introduction to State sp versa - State transitio Controllability and Obse	STATE SPACE MODEL OF SYSTEMS Dace – State Equations – Conversion of State space to transfer funct n matrix - Solution of state equation through Laplace transform ervability - Gilbert's test - Kalman's test.	9 ion and vice n method
UNIT V Introduction to State sp versa - State transitio Controllability and Obse	STATE SPACE MODEL OF SYSTEMS Dace – State Equations – Conversion of State space to transfer function n matrix - Solution of state equation through Laplace transform ervability - Gilbert's test - Kalman's test. TOTAL: 4	9 ion and vice n method 45 PERIODS
UNIT V Introduction to State sp versa - State transitio Controllability and Obse TEXT BOOKS:	STATE SPACE MODEL OF SYSTEMS pace – State Equations – Conversion of State space to transfer function n matrix - Solution of state equation through Laplace transform ervability - Gilbert's test - Kalman's test. TOTAL: 4	9 ion and vice n method 45 PERIODS
UNIT V Introduction to State sp versa - State transitio Controllability and Obse TEXT BOOKS: 1. Norman.S.Nise	STATE SPACE MODEL OF SYSTEMS bace – State Equations – Conversion of State space to transfer function in matrix - Solution of state equation through Laplace transform ervability - Gilbert's test - Kalman's test. TOTAL: 4 'Control Systems Engineering', Wiley Student Edition, 5 th Edition 20	9 ion and vice n method - 45 PERIODS
UNIT V Introduction to State sp versa - State transitio Controllability and Obso TEXT BOOKS: 1. Norman.S.Nise 2. Richard.C.Dorf 2011.	STATE SPACE MODEL OF SYSTEMS Dace – State Equations – Conversion of State space to transfer function in matrix - Solution of state equation through Laplace transformervability - Gilbert's test - Kalman's test. TOTAL: 4 'Control Systems Engineering', Wiley Student Edition, 5 th Edition 20 and Robert.H.Bishop 'Modern Control Systems', Pearson Education,	9 ion and vice n method - 45 PERIODS 12 11 th Editior
UNIT V Introduction to State sp versa - State transitio Controllability and Obso TEXT BOOKS: 1. Norman.S.Nise 2. Richard.C.Dorf 2011. REFERENCE BOOKS:	STATE SPACE MODEL OF SYSTEMS Dace – State Equations – Conversion of State space to transfer function n matrix - Solution of state equation through Laplace transform ervability - Gilbert's test - Kalman's test. TOTAL: 4 'Control Systems Engineering', Wiley Student Edition, 5 th Edition 20 and Robert.H.Bishop 'Modern Control Systems', Pearson Education,	9 ion and vice n method 45 PERIODS 12 11 th Editior
UNIT V Introduction to State sp versa - State transitio Controllability and Obse TEXT BOOKS: 1. Norman.S.Nise 2. Richard.C.Dorf 2011. REFERENCE BOOKS: 1. Kaitshiko Ogata	STATE SPACE MODEL OF SYSTEMS Dace – State Equations – Conversion of State space to transfer function matrix - Solution of state equation through Laplace transformervability - Gilbert's test - Kalman's test. TOTAL: 4 'Control Systems Engineering', Wiley Student Edition, 5 th Edition 20 and Robert.H.Bishop 'Modern Control Systems', Pearson Education, a "Modern Control Engineering" Pearson Education" 2010 Edition.	9 ion and vice n method 45 PERIODS 12 11 th Edition
UNIT V Introduction to State sp versa - State transitio Controllability and Obse TEXT BOOKS: 1. Norman.S.Nise 2. Richard.C.Dorf 2011. REFERENCE BOOKS: 1. Kaitshiko Ogata 2. John J Azzo a MATLAB", Mar	STATE SPACE MODEL OF SYSTEMS pace – State Equations – Conversion of State space to transfer function matrix - Solution of state equation through Laplace transformervability - Gilbert's test - Kalman's test. TOTAL: 4 'Control Systems Engineering', Wiley Student Edition, 5 th Edition 20 and Robert.H.Bishop 'Modern Control Systems', Pearson Education, a "Modern Control Engineering" Pearson Education" 2010 Edition. nd Constantine H.Houpis "Linear Control Systems analysis and E cel Dekker Inc, 6 th Edition 2013.	9 ion and vice n method 45 PERIODS 12 11 th Edition Design with
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COL	IRSE CODE:	COURSE TITLE:	L	Т	Р	С
10	211EE106	MEASUREMENTS AND INSTRUMENTATION	2	0	0	2
COURSE	CATEGORY: Prog	ramme Core				
PREAMB	LE: To provide	adequate knowledge in electrical and el	ectronic	instr	uments	and
measure	ments techniques					
PREREQU	JISITE COURSES:	Basic Electronics and Measurement Engineering				
RELEVAN	T COURSES: Line	ar Control Systems				
COURSE	EDUCATIONAL O	BJECTIVES:				
The obje	ctives of the cours	se are to,				
• L	Inderstand gener	al instrumentation system, error and calibration				
• L	Inderstand analog	g and digital techniques to measure voltage, curre	ent, ener	gy and	power	
• 0	Compare AC and D)C bridges.				
• E	laborate discussion	on about storage & display devices.				
• S	tudy different tra	nsducers and data acquisition system				
COURSE	OUTCOMES:					
Upor	the successful co	ompletion of the course, students will be able to:		<u> </u>	1/2	
со		Course Outcomes	Knowl on r	edge Lo revised	evel (Ba Bloom	ased 's
Nos.			0	Taxon	omy)	•
CO1	Explain about ca	alibration, classify errors and standards		К2		
CO2	Illustrate types	of electrical and electronic instruments		К2		
CO3	Explain about ty	pes of bridges required for measurements		К2		
CO4	Explain about ty	pes of display measurement devices		K2		
COF	Explain the t	ypes of transducers required for energy		V 1		

CORRELATION OF COS WITH POS AND PSOS

conversion

CO5

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н										L	Н	L
CO2	Н	Н										L	Н	L
CO3	Н	Н										L	Н	L
CO4	Н	Н										L	Н	L
CO5	Н	Н										L	Н	L
		•	•	•	•	•	•	•	•	•	•	•	•	•

К2

COURSE CONTENT:								
UNIT I	INTRODUCTION	6						
Functional elements of an instrument – static and dynamic characteristics – errors in measurement – statistical evaluation of measurement data – standards and calibration.								
UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 6								
Principle and types of analog and digital voltmeters, ammeters, multimeters – single and three phase wattmeters and energy meters -instrument transformers – instruments for measurement of frequency and phase.								
UNIT III	DC AND AC BRIDGES	6						
DC bridges: bridge and A	Wheatstone bridge, Kelvin's Bridge. AC bridges: Maxwell's bri nderson bridge.	dg, Schering bridge, Wein						
UNIT IV	STORAGE AND DISPLAY DEVICES	6						
Magnetic disk and tape – recorders, CRT display, digital CRO, LED, LCD & dot matrix display. Study of modern printers and display devices.								
UNIT V	TRANSDUCERS AND DATA ACQUISITION SYSTEMS	6						
Classification of transducers – selection of transducers – resistive, capacitive & inductive transducers – temperature transducers: thermistor, thermocouple - LVDT, pressure transducers– strain gauges – Piezo electric – elements of data acquisition system.								
		TOTAL: 30 PERIODS						
TEXT BOOKS	:							
1. E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003.								
 A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2004. 								
REFERENCE BOOKS:								
1. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2003.								
2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, 1995.								
3. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.								
4. J. B. 2003	Gupta, 'A Course in Electronic and Electrical Measurements', :	S. K. Kataria& Sons, Delhi,						
5. Davi Pres	d A Bell, Electronic Instrumentation and Measurement, Third s, 2008.	Edition, Oxford University						
6. <u>https://onlinecourses.nptel.ac.in/noc22_ee112/preview</u>								

COU									L	Т	Ρ	С							
10	D211EE107TRANSMISSION AND DISTRIBUTION									3	0	0	3						
COURSE CATEGORY: Programme Core																			
PREAMBLE: To become familiar with the estimation of different line parameters in Transmission lines of power systems, modelling of the transmission lines for computing performance parameters, performance of insulators used in transmission lines and determining the voltage drop in various type of distributers.													sion ers, ous						
PREREQUISITE COURSES: Electromagnetic fields, Circuit Analysis																			
RELATED COURSES: Power System Analysis, Power System Operation & Control																			
COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to:																			
•	Obtai and e	n the e fficienc	quivale cy.	ent circ	uits of	the tra	insmiss	ion line	es for d	etermi	ining vo	oltage	regula	tion	I				
•	Acqui	re knov	wledge	on me	echanic	al desi	gn of o	verhea	d lines	and ins	sulator	s.							
•	Unde	rstand	the typ	pes of u	Indergr	ound o	ables.												
•	Calcu	late the	e volta	ge drop	o on DC	and A	C distri	butors	•										
COURSE		COMES	5:					COURSE OUTCOMES:											
Upc	Soon the successful completion of the course, students will be able to: Course Outcomes Knowledge Level (Based on revised Bloom's																		
CO Nos.				Co	ourse C	ne cour Outcom	rse, stu I es	dents v	vill be a	able to	: Know on	ledge L revised Taxon	.evel (d Bloo omv)	Base m's	ed				
CO Nos.	Con	struct t orman	he trar	Co nsmissi ameters	on line s.	outcom	rse, stu nes ls and s	dents v solve fo	vill be a	able to	: Know on	ledge L revised Taxon K	.evel (l Bloo omy) 3	Baso m's	ed				
CO Nos. CO1 CO2	Con: perf Deve base effic	struct t orman elop th ed on d iency.	he trar ce para e equiv istance	Co nsmissi ameters valent o e and do	on line s. circuits etermin	Dutcom model for the ne volt	es stu s and s transi age reg	dents v olve fo mission gulatior	r its lines	able to	: Know on	ledge L revised Taxon K:	evel (d Bloo omy) 3	Baso m's	ed				
CO Nos. CO1 CO2 CO3	Con: perf Deve base effic Iden	struct t orman elop th ed on d iency. tify the lators.	he trar ce para e equiv istance e perfo	Cc nsmissi ameters valent c e and d rmance	on line s. circuits etermine e paran	Dutcom model for the ne volt neters	e transi age reg	dents v olve fo mission gulatior rhead li	r its lines and nes an	able to	: Know on	ledge L revised Taxon K: K:	evel (d Bloo omy) 3 3 3	(Bas) m's	ed				
CO Nos. CO1 CO2 CO3 CO4	Con: perf Deve base effic Iden insu Expl	struct t orman elop th ed on d iency. tify the lators. ain the	he trar ce para e equiv istance e perfo types	Cc nsmissi ameters valent c e and d rmance and ch	on line s. circuits etermine e paran	Dutcom model for the ne volt neters	is and s s and s transi age reg of over	dents v colve fo mission gulation rhead li rgroun	r its lines n and nes an d cable	d d	: Know on	ledge L revised Taxon K: K: K:	evel (d Bloo omy) 3 3 3 2	Bası m's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5	Con perf Deve base effic Iden insu Expl Cho perf	struct t orman elop th ed on d iency. tify the lators. ain the ose the orman	he trar ce para e equiv istance e perfo types e type c ce para	Co nsmissi ameters valent of and do rmance and ch of DC an ameters	on line s. circuits etermin e paran aracter nd AC c s	outcom model for the ne volt ristics c distribu	is and s s and s s and s e transi age reg of over of onde itors ar	dents v colve fo mission gulatior rhead li rgroun nd solve	r its lines and nes an d cable e for its	d d	: Know on	ledge L revised Taxon K: K: K: K:	evel (d Bloo omy) 3 3 3 2 3	(Bason m's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5	Con: perf Deve base effic Iden insu Expl Cho perf	struct t orman elop th ed on d iency. tify the lators. ain the ose the orman	he trar ce para e equiv istance e perfo types e type c ce para Ds WIT	Co nsmissi ameters valent of and do rmance and ch of DC an ameters	on line s. circuits etermin e paran aracter nd AC c s AND P	Dutcom model for the ne volt neters distribu	is and s s and s transi age reg of over of unde	dents v colve fo mission gulation rhead li rgroun nd solve	r its lines n and d cable e for its	d d	: Know on	ledge L revised Taxon K: K: K: K:	evel (d Bloo omy) 3 3 3 2 3	(Basi m's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5 CORREL COS	Con: perf Deve base effic Iden insu Expl Cho perf ATIOI	struct t orman elop th ed on d iency. tify the lators. ain the ose the orman N OF CO	he trar ce para e equiv istance e perfo types e type c ce para Ds WIT PO3	Co nsmissi ameters valent of and da rmance and ch of DC an ameters H POS	on line s. circuits etermin aracter nd AC c s AND PS	ne cour Dutcom model for the ne volt neters distribu SOs PO6	e transi age reg of over tors ar	dents v colve fo mission gulatior rhead li rgroun nd solve	r its lines and d cable e for its	d s. PO10	: Know on	ledge L revised Taxon K: K: K: K: K: PO12	evel (d Bloo omy) 3 3 3 2 3 2 3 2 2 3	(Bask m's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5 CORREL COs CO1	Con: perf Deve base effic Iden insu Expl Cho perf ATIOI H	struct t orman elop th ed on d iency. tify the lators. ain the ose the orman N OF CO PO2 H	he trar ce para e equiv istance e perfo types e type c ce para Ds WIT PO3 M	Co nsmissi ameters valent of and ch of DC an ameters H POs a PO4	on line s. circuits etermin aracter nd AC c s AND PS PO5	Dutcom model for the ne volt neters istics c distribu SOs PO6	Is and s s and s e transi age reg of over of unde itors ar PO7 L	dents v colve fo mission gulatior rhead li rgroun nd solve	r its lines n and d cable e for its	d PO10	E Know on PO11	ledge L revised Taxon K K K K K	evel (d Bloo omy) 3 3 3 3 2 3 2 1 3 2 1 3 1 3 1 2 1 3 1 1 1 1	(Basom's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5 CORREL COs CO1 CO2	Con: perf Deve base effic Iden insu Expl Choo perf ATIOI H H	struct t orman- elop th ed on d iency. tify the lators. ain the ose the orman- N OF CO PO2 H H	he trar ce para e equiv istance e perfo types e type c ce para Ds WIT PO3 M M	Co nsmissi ameters valent c and d rmance and ch of DC an ameters TH POS	on line s. circuits etermin e paran aracter nd AC c s AND PS	ne cour Dutcom model for the ne volt neters distribu SOs PO6	e transi age reg of over tors ar PO7 L	dents v colve fo mission gulatior rhead li rgroun nd solve	r its lines n and nes an d cable e for its	d PO10	: Know on PO11 L L	ledge L revised Taxon K: K: K: K: K: PO12 L L	evel (d Bloo omy) 3 3 3 2 3 2 3 PSO 2 H H	Basi m's	ed				
CO Nos. CO1 CO2 CO3 CO4 CO5 CORREL COs CO1 CO2	Con: perf Deve base effic Iden insu Expl Cho perf ATIOI H H H	struct t orman- elop th ed on d iency. tify the lators. ain the ose the orman- N OF CO PO2 H H H	he trar ce para e equivi istance e perfo types e type c ce para Ds WIT PO3 M M M	Cc nsmissi ameter: valent c and d rmance and ch of DC an ameter: H POs	on line s. circuits etermin e paran aracter nd AC c s AND P: PO5	ne cour Dutcom model for the ne volt neters istics c distribu SOs PO6	e transi age reg of over of unde tors ar PO7 L	olve for mission gulation regroun nd solve	r its lines and nes an d cable e for its	d PO10	E Know on PO11	ledge L revised Taxon K: K: K: K: K: PO12 L L L	evel (d Bloo omy) 3 3 3 2 3 PSO 1 H H H	Easi m's	ed 				
CO Nos. CO1 CO2 CO3 CO4 CO5 CORREL COs CO1 CO2 CO3 CO4 CO5 CO1 CO3 CO4	Con: perf Deve base effic Iden insu Expl Cho perf ATIOI H H H H	struct t orman elop th ed on d iency. tify the lators. ain the ose the orman N OF CO PO2 H H H H M	he trar ce para e equivi istance e perfo types e type c ce para Ds WIT PO3 M M M L	Co nsmissi ameters valent of and ch of DC an ameters TH POS	on line s. circuits etermin aracter nd AC c s AND P: PO5	ne cour Dutcom model for the ne volt neters distribu SOs PO6	e transi age reg of over f unde tors ar PO7 L	olve for mission gulation regroun nd solve	r its lines n and nes an d cable e for its	d PO10	: Know on PO11 L L	ledge L revised Taxon K: K: K: K: PO12 L L	evel (d Bloo omy) 3 3 3 2 3 2 3 3 4 4 H H H H H	E PS	ed				

UNIT I TRANSMISSION LINE PARAMETERS 9 Parameters of single and three phase transmission lines with single and double circuits - Resistance inductance and capacitance of solid, stranded and bundled conductors, Symmetrical an unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximit effects UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9 Classification of lines - short line, medium line and long line - equivalent circuits, phasor diagram attenuation constant, phase constant, surge impedance; transmission efficiency and voltag regulation, real and reactive power flow in lines- surge impedance loading- Ferranti effect. UNIT III INSULATORS & MECHANICAL DESIGN OF LINES 9 Mechanical design of Overhead lines – Line supports – Overhead line insulators – Classification Voltage distribution in suspension insulators - string efficiency – Stress and Sag calculation – effect of wind and ice - Formation of Corona - critical voltages - losses - effect on line performance. 9 Comparison between overhead line and underground cable – Constructional features - Types of cables - insulation resistance - potential gradient - capacitance of single core and three core cables grading of cables - Types of grading of cables. 9 DC Distributors: Concentrated and distributed loads - Two wire distributor- radial distributor - fed a one end - fed at both ends - Ring main feeder - Advantages - Three wire distributor. 9 DC Distributors: Concentrated loads with power factor refers to load point - refer to common load three phase three wire and t	COURSE	CONTENT:							
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UNIT IVUNDERGROUND CABLES9Comparison between overhead line and underground cable – Constructional features - Types of cables - insulation resistance - potential gradient - capacitance of single core and three core cables grading of cables - Types of grading of cables.9UNIT VDISTRIBUTORS9DC Distributors: Concentrated and distributed loads - Two wire distributor- radial distributor - fed a one end - fed at both ends - Ring main feeder - Advantages - Three wire distributor.9AC Distributors: Concentrated loads with power factor refers to load point - refer to common load three phase three wire and three phase four wire distributors.TOTAL: 45 PERIODSTEXT BOOKS:1.Wadhwa,C.L., 'Electrical power systems', New age International Pvt Ltd. publishers,1995. 2.Gupta B.R., 'Power system Analysis & Design', Wheeler Publishing, 2006.	Mechanical design of Overhead lines – Line supports – Overhead line insulators – Classification - Voltage distribution in suspension insulators - string efficiency – Stress and Sag calculation – effects of wind and ice - Formation of Corona - critical voltages - losses - effect on line performance.								
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UNIT V DISTRIBUTORS 9 DC Distributors: Concentrated and distributed loads - Two wire distributor- radial distributor - fed a one end - fed at both ends - Ring main feeder - Advantages - Three wire distributor. AC Distributors: Concentrated loads with power factor refers to load point - refer to common load three phase three wire and three phase four wire distributors. TOTAL: 45 PERIODS TEXT BOOKS: 1. Wadhwa,C.L., 'Electrical power systems', New age International Pvt Ltd. publishers,1995. 2. Gupta B.R., 'Power system Analysis & Design', Wheeler Publishing, 2006.	Comparis cables - ii grading o	Comparison between overhead line and underground cable – Constructional features - Types of cables - insulation resistance - potential gradient - capacitance of single core and three core cables - grading of cables - Types of grading of cables.							
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 Wadhwa,C.L., 'Electrical power systems', New age International Pvt Ltd. publishers,1995. Gupta B.R., 'Power system Analysis & Design', Wheeler Publishing, 2006. 	TEXT BOO	DKS:							
2. Gupta B.R., 'Power system Analysis & Design', Wheeler Publishing, 2006.	1. V	/adhwa,C.L., 'Electrical power systems', New age International Pvt Ltd. pub	olishers,1995.						
	2. Gupta B.R., 'Power system Analysis & Design', Wheeler Publishing, 2006.								
REFERENCE BOOKS:									
1. Cotton H., 'Transmission and distribution of electrical Energy', ELBS,1985.	1. C	otton H., 'Transmission and distribution of electrical Energy', ELBS,1985.							
 A. Chakrabarti ,P. V. Gupta , Soni M, Text Book on 'Power System Engineering', Wheele Publishing, 2009. 	2. A P	A. Chakrabarti ,P. V. Gupta , Soni M, Text Book on 'Power System Engin ublishing, 2009.	neering', Wheeler						
3. V.K. Mehta, Rohit Mehta, 'Principles of power system' Chand publications, 4 th Edition.	3. V	.K. Mehta, Rohit Mehta, 'Principles of power system' Chand publications, 4	th Edition.						
4. <u>https://onlinecourses.nptel.ac.in/noc22_ee98/preview</u>	4. <u>h</u>	ttps://onlinecourses.nptel.ac.in/noc22_ee98/preview							

COURSE CODE: 10211EE108		COURSE TITLE:							L	Т	Р	С			
			POWER ELECTRONICS							0	0	3			
COURSE CATEGORY: Programme Core															
PREAMBLE: This course is being a core of power and energy control, forms the basis for understanding the efficient conversion, control and conditioning of electric power from its' available input into the desired electrical output form by using electronic devices.															
PREREQUISITE COURSES: Circuit Analysis, Electronic Circuits															
RELATED COURSES: LED Lighting Technology, Solid State Drives															
COURS	E EDU		IAL OB.	JECTIVE	ES:										
 COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, Get an overview of different types of power semi-conductor devices and their switching characteristics. Understand the operation, characteristics and performance parameters of controlled rectifiers. Study the operation, switching techniques and basic topologies of DC-DC switching regulators. Learn the different modulation techniques of stepped and pulse width modulated inverters and to understand the harmonic reduction methods. Know the practical applications of power electronics converters in conditioning the power 															
COURS	EOUT		:												
Up	on the	succes	sful cor	npletio	n of th	e cours	e, stud	ents wi	ill be al	ole to:					
CO Nos					Course	Outco	mes				Level of learning domain (Based on revised Bloom's taxonomy)				
CO1	E> SV	kplain vitching	types g chara	of pov cteristi	ver se cs.	mi-con	ductor	device	es and	their		К2			
CO2		ompare	the ers of c	operat	ion, c ed rect	haracte	eristics	and	perforr	nance		K	<2		
CO3		ompare	the the	operat	ion, s	witchin	g tecl	nniques	and	basic		К2			
CO4	Su h	Summarize techniques of pulse width modulated inverters an								rs and	К2				
CO5	CO5 Identify practical and theoretical situations where AC voltage controller & Cyclo converter find their applications.								oltage	КЗ					
CORRE		N OF CO	Ds WITI	H POs A	AND PS	Os									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	Н	L	М		Н							L	L	L	
CO2	Н	L	Μ		Н							L	Н	L	
CO3	Н	L	М		Н								Н	L	
CO4	Н	L	М		Н								Н	L	
CO5	Н	L	М		Н							L	Н	L	

COURSE CONT	ENT:								
UNIT I	POWER SEMI-CONDUCTOR DEVICES	9							
Power switching devices overview: ideal & real switching characteristics - power diode, BJT, SCR, TRIAC, MOSFET, GTO, IGBT - VI characteristics, Turn-on, Turn-off methods; protection - di/dt, dv/dt, over current, over voltage, specifications, losses, thermal characteristics, series and parallel operation, triggering circuits.									
UNIT II CONTROLLED RECTIFIERS 9									
Operation and analysis of single and three phase rectifiers – half and fully controlled converters with R, RL and RLE loads with and without freewheeling diodes; converter and inverter operation – wave forms, gate time control, output voltage, input current, power factor, effect of load and source inductance. Commutation Techniques - Power factor and harmonic improvement methods – multi- phase width controlled, symmetrical angle controlled; series converter; dual converter modes – four- quadrant operation with and without circulating current modes: firing circuits									
UNIT III	CHOPPERS	9							
Principles of high-power chopper circuits – voltage commutated, current commutated chopper, multi- phase chopper, multi-quadrant operation, switch mode regulators – principle of operation of buck, boost and buck boost regulators - time ratio control, variable frequency control, duty cycle.									
UNIT IV	INVERTERS	9							
Principles of high power VSI and CSI inverters, Modified McMurray, auto sequential inverter– waveforms at load and commutating elements, analysis of three phase inverter circuits with star and delta loads - control and modulation techniques - unipolar, bipolar inverters – voltage and frequency control - harmonics study.									
UNIT V	AC CHOPPER AND CYCLOCONVERETERS	9							
Principle of single phase and three-phase AC voltage controller – ON/OFF and phase angle control - principle of single phase and three phase Cyclo converters circuits, different control techniques and firing pulse generation – Applications - VVVF. UPS. Fan Regulator.									
TOTAL: 45 PERIODS									
TEXT BOOKS:									
1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education/Prentice Hall, 2004.									
2. Singh, M.D. and Khanchandani, K.B., "Power Electronics", 2nd Edition, Tata McGraw Hill, 2004.									
REFERENCE BOOKS:									
1. Bhimbra, P. S., "Power Electronics", 4 th Edition, Dhanpat Rai and Sons, 2000.									
2. Bimal K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2003.									
Z. Bimai	K. Bose, "Modern Power Electronics and AC Drives", Pearson	Education, 2003.							
3. Ned N and De	K. Bose, "Modern Power Electronics and AC Drives", Pearson Iohan, Tore M. Undeland, William P. Robbins, "Power Electro esign", 3rd Edition, John Wiley and Sons, 2003.	Education, 2003. nics Converters Applications							
 Binnar Ned N and D Cyril V 	K. Bose, "Modern Power Electronics and AC Drives", Pearson Iohan, Tore M. Undeland, William P. Robbins, "Power Electro esign", 3rd Edition, John Wiley and Sons, 2003. V.Lander, "Power Electronics", McGraw-Hill, International edi	Education, 2003. nics Converters Applications tion, New Delhi, 1993.							

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10211EE109	POWER SYSTEM ANALYSIS	3	1	0	4

COURSE CATEGORY: Programme Core

PREAMBLE: The course provides to the students with essential knowledge in power systems required for its analysis. It includes per-unit system, line models, application of network matrices techniques, power flow calculation for the steady-state and analysis, power system fault analysis including: symmetrical faults and unsymmetrical faults and power system stability.

PREREQUISITE COURSES: Transmission & Distribution

RELATED COURSES: Power System Operation and Control

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Introduce the characteristics of different transmission line models, steady state analysis and transient analysis of power systems
- Understand and performs the load flow analysis calculation for a power system network
- Analyse short circuit faults in power system.
- Provide the basic concept on power system stability

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the fundamentals of power systems analysis and the modelling for power systems component	К2
CO2	Perform load flow analysis	К3
CO3	Identify symmetrical faults in power systems	К3
CO4	Analyze unsymmetrical faults in power systems	К4
CO5	Perform transient stability analysis of power systems	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	L	L								Н	L
CO2	Н	Н	Н	М	L						L	L	Н	L
CO3	Н	Н	Н	М	L		L				L	L	Н	L
CO4	Н	Н	Н	М	L		L				L	L	Н	L
CO5	Н	М	Μ	М								L	Н	L

COURSE CONTENT:								
UNIT I THE POWER SYSTEM – AN OVERVIEW AND MODELLING								
Modern Power System - Basic Components of a power system - Per Phase Analysis Generator model - Transformer model - line model - The per unit system - Change of base.								
UNIT II POWER FLOW ANALYSIS 12								
Introduction - Gauss-Seidel r comparison of	Introduction - Bus Classification - Bus admittance matrix - Solution of non-linear Algebraic equations - Gauss-Seidel method - Newton Raphson method - Fast decoupled method - Flow charts and comparison of the three methods.							
UNIT III	FAULT ANALYSIS-BALANCED FAULT	12						
Introduction – impedance ma	Balanced three phase fault – short circuit capacity – syster trix – algorithm for formation of the bus impedance matrix.	matic fault analysis using bus						
UNIT IV	FAULT ANALYSIS – SYMMETRICAL COMPONENTS AND UNBALANCED FAULT	12						
Introduction – – single line to bus impedance	Introduction – Fundamentals of symmetrical components – sequence impedances – sequence networks – single line to ground fault – line fault - Double line to ground fault – Unbalanced fault analysis using bus impedance matrix.							
UNIT V	POWER SYSTEM STABILITY	12						
Basic concepts and definitions of stability – Classification of stability –Swing equation–Transient stability – Equal area criterion – Reponses to a short circuit fault- Factors influencing Transient stability – Numerical integration methods –Modified Euler method – Runge – Kutta methods.								
TOTAL: 60 PERIODS								
TEXT BOOKS:								
 Hadi Saadat "Power System Analysis", Tata McGraw Hill Publishing Company, New Delhi, 2002 P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company, New Delhi, 1994 								
REFERENCE BOOKS:								
 I.J.Nagrath and D.P.Kothari, 'Modern Power System Analysis', Tata McGraw-Hill publishing company, New Delhi, 1990. https://pntel.ac.in/courses/108105104 								
 REFERENCE BOOKS: 1. I.J.Nagrath and D.P.Kothari, 'Modern Power System Analysis', Tata McGraw-Hill publishing company, New Delhi, 1990. 2. <u>https://nptel.ac.in/courses/108105104</u> 								
COURSE CODE: COURSE TITLE:	L	Т	Р	С				
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				L				
POWER SYSTEM OPERATION AND CONTROL	3	0	0	3				
COURSE CATEGORY: Programme Core								
PREAMBLE: This course discussed about the preparatory work necessary operation and the various control actions to be implemented on the Power variations in load.	for me system	eeting t networ	he next k to me	day's et the				
PREREQUISITE COURSES: Power System Analysis								
RELATED COURSES: Protection and Switchgear								
COURSE EDUCATIONAL OBJECTIVES:								
The objectives of the course are to,								
• Get an overview of real and reactive power operation and control.								
Estimate the load demand and commit the generating units according	gly.							
Create awareness on recent trends in power system operation and co	ontrol.							
COURSE OUTCOMES:								
Upon the successful completion of the course, students will be able to:								
CO Nos. Course Outcomes	Level (Based	of learn I on revi taxono	ing dom ised Blo omy)	1ain om's				
CO1 Illustrate the importance of system frequency and voltage regulation in recent time.		К2	2					
CO2 Summarize methods in Forecasting of base load and Unit commitment.		K2	2					
CO3 Explain plant level and system level control of real power.		K2)					
CO4 Solve Economic Dispatch problem including losses and lossless power system and Make use of controller for load frequency control.		K3	8					
CO5 Identify generation and absorption of Reactive power and methods of voltage control.		KB	}					

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L								L		L	Н	L
CO2	Н	Μ	М	L	L					L			Н	L
CO3	Н	Μ	М	L	М					L			Н	L
CO4	Н	М	М	L	М					L			Н	L
CO5	Н	L								L		L	Н	L

COURSE CON	TENT:	
UNIT I	INTRODUCTION	9
Approach ad for regulation control of po	opted in utilities for providing reliable, quality and economic elected of system frequency and voltage - P-F and Q-V control structure wer systems.	tric power supply - Necessity e - recent trends in real time
UNIT II	LOAD FORECASTING AND UNIT COMMITMENT	9
Load forecas method of le commitment	ing - components of system load - classification of base load - fo east square fit - Introduction to unit commitment - constraints using priority list method and dynamic programming.	recasting of the base load by s in unit commitment - unit
UNIT III	REAL POWER CONTROL	9
LOCAL CONT governing me in parallel. SYSTEM CON dynamic ana of two area s of two area.	ROL: Power control mechanism of individual machine - matechanism - speed load characteristics of governing mechanism - F TROL: Division of power system into control areas - LFC control ysis of uncontrolled system - proportional plus integral control of ystem - uncontrolled case - static and dynamic response - Tie line	thematical model of speed Regulation of two generators of a single area - static and of a single area - LFC control, e with frequency bias control
UNIT IV	ECONOMICS DISPATCH	9
Incremental ordination en equations us dispatch cont	cost curve - co-ordination equations with losses neglected - quations with loss included (No derivation of BMN co-efficient ing BMN co-efficient by iteration method - Base point and part proller added to LFC.	solution by iteration - co-) - solution of co-ordination cicipation factors - Economic
UNIT V	PRIORITY POWER CONTROL	9
LOCAL CONT system SYSTEM CON reactive pow	ROL: Fundamental characteristics of excitation system - Block dia TROL: Generation and absorption of reactive power - method of er - static shunt capacitor/inductor VAR compensator - tap chang	gram model of exciter voltage control - injection of ing transformer.
		TOTAL: 45 PERIODS
TEXT BOOKS		
1. Olle comp	. Elgerad, "Electric Energy System Theory and Introduction", T Dany, New Delhi, 1983.	ata Mc Graw Hill publishing
2. I.J.Na 1998	grath, D.P.Kothari, "Power System Engineering", Tata Mc Graw I	Hill publishing company Ltd.,
3. Allen Sons,	J.Wood, Bruce F. Wollenbarg, "Power Generation, Operation a 1984.	nd Control", John Wiley and
REFERENCE E	SOOKS:	
1. B.M. Amst	Weedy, "Electric Power System", John Wiley & Sons, Els erdam, 1972.	evier publishing company,
2. A.K.N Tata	1ahalanbias, D.P.Kothari & S.I.Ahson, "Computer Aided Power S Mc Graw Hill publishing company, New Delhi, 1990.	ystem Analysis and Control"
3. Prab	na Kundur "Power System Stability and Control", McGraw-Hill Pro	ofessional, 1994.
4. <u>https</u>	://nptel.ac.in/courses/108105104	

COURSE CODE: 10211EE111COURSE TITLE: ELECTRICAL MACHINE DESIGNLTPC3104COURSE CATEGORY: Programme CorePREAMBLE: This course Electrical machine design provides an introduction to the design of various DC and AC Machines and gives a general idea to the computer aided design of Electrical machines.PREREQUISITE COURSES: DC Machines and Transformers, AC MachinesRELATED COURSES: DC Machines and Transformers, AC MachinesCOURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, • Expose the students towards the design of various types of electrical machines • Understand the basic concept of armature and field winding of DC machine • Understand the concept of induction machine • Understand the concept of function machine • Understand the concept of synchronous machineCOURSE COURSES: COURSE COURSES: Upon the successful completion of the course, students will be able to:CO Course OutcomesLevel of learning domain (Based on revised Bloom's taxonomy)CO1 various types of electrical machines.K2CO2 Explain armature and field systems for D.C machines.K2CO3 CO3 Demonstrate the design of stator and rotor of induction machines.K2CO4 COA Construct the design of stator and rotor of induction machines.K3	-			1	1	1	1	
10211EE111ELECTRICAL MACHINE DESIGN3104COURSE CATEGORY: Programme CorePREAMBLE: This course Electrical machine design provides an introduction to the design of various DC and AC Machines and gives a general idea to the computer aided design of Electrical machines.PREREQUISITE COURSES: DC Machines and Transformers, AC MachinesRELATED COURSES: DC Machines and Transformers, AC MachinesCOURSES: DC Machines and Transformers, AC MachinesUnderstand the course are to,• Understand the basic concept of armature and field winding of DC machine• Understand the concept of induction machine• Understand the concept of synchronous machine• Understand the concept of synchronous machine• Understand the concept of MMF calculation and thermal rating of various types of electrical machines.• COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: <td colsp<="" td=""><td>cou</td><td>IRSE CODE:</td><td>COURSE TITLE:</td><td>L</td><td>Т</td><th>Р</th><td>C</td></td>	<td>cou</td> <td>IRSE CODE:</td> <td>COURSE TITLE:</td> <td>L</td> <td>Т</td> <th>Р</th> <td>C</td>	cou	IRSE CODE:	COURSE TITLE:	L	Т	Р	C
COURSE CATEGORY: Programme Core PREAMBLE: This course Electrical machine design provides an introduction to the design of various DC and AC Machines and gives a general idea to the computer aided design of Electrical machines. PREREQUISITE COURSES: DC Machines and Transformers, AC Machines RELATED COURSES: DC Machines and Transformers, AC Machines Understand the course are to, Understand the basic concept of armature and field winding of DC machine Understand the concept of induction machine Understand the concept of synchronous machine COURSE OUTCOMES: Level of learning domain (Based on revised Bloom's taxonomy) CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines.	102	211EE111	ELECTRICAL MACHINE DESIGN	3	1	0	4	
PREAMBLE: This course Electrical machine design provides an introduction to the design of various DC and AC Machines and gives a general idea to the computer aided design of Electrical machines. PREREQUISITE COURSES: DC Machines and Transformers, AC Machines RELATED COURSES: DC Machines and Transformers, AC Machines COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, • Expose the students towards the design of various types of electrical machines • Understand the basic concept of armature and field winding of DC machine • Understand to basic design and cooling system of electrical transformer • Understand the concept of induction machine • Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO Course Outcomes (Based on revised Bloom's taxonomy) CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K2 CO4 Construct the design of stator and rotor of induction machines. K3 CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. K3 <td>COURSE C</td> <td>ATEGORY: Program</td> <td>nme Core</td> <td></td> <td></td> <th></th> <td></td>	COURSE C	ATEGORY: Program	nme Core					
AC Machines and gives a general idea to the computer aided design of Electrical machines. PREREQUISITE COURSES: DC Machines and Transformers, AC Machines RELATED COURSES: DC Machines and Transformers, AC Machines COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, Expose the students towards the design of various types of electrical machines Understand the basic concept of armature and field winding of DC machine Understand the basic design and cooling system of electrical transformer Understand the concept of induction machine Understand the concept of synchronous machine Understand the concept of synchronous machine Upon the successful completion of the course, students will be able to: COURSE OUTCOMES: Upon the successful completion and thermal rating of Nos. CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. CO3 Demonstrate the design and cooling system of transformers. CO4 Construct the design of stator and rotor of induction machines. CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. CO3	PREAMBL	E: This course Elec	trical machine design provides an introduction to	o the de	sign of v	various	DC and	
PREREQUISITE COURSES: DC Machines and Transformers, AC Machines RELATED COURSES: DC Machines and Transformers, AC Machines COURSES: DC Machines and Transformers, AC Machines COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, • Expose the students towards the design of various types of electrical machines • Understand the basic concept of armature and field winding of DC machine • Understand the concept of induction machine • Understand the concept of induction machine • Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. K2 CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K2 CO4 Construct the design of stator and rotor of induction machines. K3 CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	AC Machir	nes and gives a gen	eral idea to the computer aided design of Electri	cal mac	hines.			
RELATED COURSES: DC Machines and Transformers, AC Machines COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, • Expose the students towards the design of various types of electrical machines • Understand the basic concept of armature and field winding of DC machine • Understand the concept of induction machine • Understand the concept of induction machine • Understand the concept of synchronous machine Course Outcomes Course Outcomes Construct the study of MMF calculation and thermal rating of various types of electrical machines. CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K2 CO4 Construct the design of stator and rotor of induction machines. K3 CO5 Choose appropriate design parameters of stator and rotor in dynamines. K3	PREREQUI	SITE COURSES: DO	Machines and Transformers, AC Machines					
COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to, Expose the students towards the design of various types of electrical machines Understand the basic concept of armature and field winding of DC machine Understand the basic concept of armature and field winding of DC machine Understand the concept of induction machine Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: Upon the successful completion of the course, students will be able to: CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. K2 CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K2 CO4 Construct the design of stator and rotor of induction machines. K3 CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	RELATED (COURSES: DC Mac	nines and Transformers, AC Machines					
The objectives of the course are to, • Expose the students towards the design of various types of electrical machines • Understand the basic concept of armature and field winding of DC machine • Understand of basic design and cooling system of electrical transformer • Understand the concept of induction machine • Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: Co Course Outcomes Level of learning domain (Based on revised Bloom's taxonomy) Co1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K2 CO4 Construct the design of stator and rotor of induction machines. K3 CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	COURSE E	DUCATIONAL OBJ	ECTIVES:					
 Expose the students towards the design of various types of electrical machines Understand the basic concept of armature and field winding of DC machine Understand of basic design and cooling system of electrical transformer Understand the concept of induction machine Understand the concept of synchronous machine Understand the concept of synchronous machine Understand the concept of the course, students will be able to: COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO Course Outcomes Level of learning domain (Based on revised Bloom's taxonomy) C01 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. K2 C02 Explain armature and field systems for D.C machines. K2 C03 Demonstrate the design and cooling system of transformers. K2 C04 Construct the design of stator and rotor of induction machines. K3 C05 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	The object	ives of the course	are to,					
 Understand the basic concept of armature and field winding of DC machine Understand of basic design and cooling system of electrical transformer Understand the concept of induction machine Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO CO Nos. Course Outcomes Level of learning domain (Based on revised Bloom's taxonomy) CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. K2 CO3 Demonstrate the design and cooling system of transformers. K3 CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. 	• Ex	pose the students	towards the design of various types of electrical	machin	es			
 Understand of basic design and cooling system of electrical transformer Understand the concept of induction machine Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO Course Outcomes Level of learning domain (Based on revised Bloom's taxonomy) C01 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. K2 C02 Explain armature and field systems for D.C machines. K2 C03 Demonstrate the design and cooling system of transformers. K2 C04 Construct the design of stator and rotor of induction machines. K3 C05 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	• Ur	nderstand the basi	c concept of armature and field winding of DC ma	achine				
 Understand the concept of induction machine Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO Level of learning domain (Based on revised Bloom's taxonomy) C01 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. K2 C02 Explain armature and field systems for D.C machines. K2 C03 Demonstrate the design and cooling system of transformers. K2 C04 Construct the design of stator and rotor of induction machines. K3 C05 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	• Ur	nderstand of basic	design and cooling system of electrical transform	ner				
 Understand the concept of synchronous machine COURSE OUTCOMES: Upon the successful completion of the course, students will be able to: CO Nos. Course Outcomes Level of learning domain (Based on revised Bloom's taxonomy) CO1 Exhibit the study of MMF calculation and thermal rating of various types of electrical machines. CO2 Explain armature and field systems for D.C machines. CO3 Demonstrate the design and cooling system of transformers. CO4 Construct the design of stator and rotor of induction machines. CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. 	• Ur	nderstand the cond	cept of induction machine					
COURSE OUTCOMES: Upon the successful completion of the course, students will be able to:CO Nos.Course OutcomesLevel of learning domain (Based on revised Bloom's 	• Ur	nderstand the cond	cept of synchronous machine					
Upon the successful completion of the course, students will be able to:CO Nos.Course OutcomesLevel of learning domain (Based on revised Bloom's taxonomy)CO1Exhibit the study of MMF calculation and thermal rating of various types of electrical machines.K2CO2Explain armature and field systems for D.C machines.K2CO3Demonstrate the design and cooling system of transformers.K2CO4Construct the design of stator and rotor of induction machines.K3CO5Choose appropriate design parameters of stator and rotor in synchronous machines.K3	COURSE O	UTCOMES:						
CO Nos.Course OutcomesLevel of learning domain (Based on revised Bloom's taxonomy)C01Exhibit the study of MMF calculation and thermal rating of various types of electrical machines.K2C02Explain armature and field systems for D.C machines.K2C03Demonstrate the design and cooling system of transformers.K2C04Construct the design of stator and rotor of induction machines.K3C05Choose appropriate design parameters of stator and rotor in synchronous machines.K3	Upon	the successful com	pletion of the course, students will be able to:					
CO1Exhibit the study of MMF calculation and thermal rating of various types of electrical machines.K2CO2Explain armature and field systems for D.C machines.K2CO3Demonstrate the design and cooling system of transformers.K2CO4Construct the design of stator and rotor of induction machines.K3CO5Choose appropriate design parameters of stator and rotor in synchronous machines.K3	CO Nos.		Course Outcomes	Level (Based	of learn d on rev taxon	ning do ised Blo omy)	main oom's	
CO2Explain armature and field systems for D.C machines.K2CO3Demonstrate the design and cooling system of transformers.K2CO4Construct the design of stator and rotor of induction machines.K3CO5Choose appropriate design parameters of stator and rotor in synchronous machines.K3	CO1	Exhibit the study various types of	of MMF calculation and thermal rating of electrical machines.		K	2		
CO3Demonstrate the design and cooling system of transformers.K2CO4Construct the design of stator and rotor of induction machines.K3CO5Choose appropriate design parameters of stator and rotor in synchronous machines.K3	CO2	Explain armature	e and field systems for D.C machines.		K	2		
CO4Construct the design of stator and rotor of induction machines.K3CO5Choose appropriate design parameters of stator and rotor in synchronous machines.K3	CO3	Demonstrate the	e design and cooling system of transformers.		K	2		
CO5 Choose appropriate design parameters of stator and rotor in synchronous machines. K3	CO4	Construct the de	esign of stator and rotor of induction machines.		K	3		
	CO5	Choose appropri synchronous ma	ate design parameters of stator and rotor in chines.		K	3		

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	М	М	М	L	L						L		М	Μ
CO2	Н	Н	Η	М	L						L		Н	М
CO3	Н	Н	Н	М	L						L		Н	М
CO4	Н	Н	Н	М	L						L		Н	М
CO5	Н	Н	Н	М	L						L		Н	М

COURSE CONT	ENT:	
UNIT I	CALCULATIONS OF MMF FOR ROTATING ELECTRICAL MACHINES	12
Major conside Magnetic circ Leakage fluxes	erations in Electrical Machine Design – Materials for Electr uits – Real and Apparent flux densities–Magnetizing current	ical apparatus – Design of : – Flux leakage –Armature
UNIT II	DESIGN OF D.C MACHINES	12
Constructiona of armature -	details of DC machine - Output equation - Choice of poles - De Design of commutators and brush - Armature reactions.	esign of field system - Design
UNIT III	DESIGN OF TRANSFORMERS	12
Constructiona - Design of cor	features - Output equation, output rating of single phase and t e, design of winding - Design of tank and cooling tubes - Tempe	hree phase, optimum design rature rise.
UNIT IV	DESIGN OF INDUCTION MACHINES	12
Constructiona cage rotor - De	details - Output equation - Choice of specific loadings – Desigr esign of slip ring rotor	n of stator–Design of squirrel
UNIT V	DESIGN OF SYNCHRONOUS MACHINES	12
Construction of machine - Sho Determination	details - Runaway speed - Output equations - Choice of load rt Circuit Ratio - Armature design - Estimation of air gap length of full load field MMF - Design of field winding - Introduction to	ling - Design of salient pole - Design of damper winding - o computer aided design
		TOTAL: 60 PERIODS
TEXT BOOKS:		
1. Mittle edition	V.M. and Mittl E.A, Design of Electrical Machines, standard pub n, 1996.	lishers Distribution, Fourth
2. Sawhr	ey, A.K. A course in Electrical Machine Design, Dhanpat Rai & so	ons, 1993.
REFERENCE BO	DOKS:	
1. Rai, H.	M. Electrical Machine Design, Sathiya Prakashan Publications, T	hird edition, 1992.
2. Say M Londo	.G., The Performance & Design of Alternating current Machin n 1995.	es Isaac Pitman & sons Ltd.,
3. Clayto Sri Isaa	n, A.E., Performance & Design of Direct current Machines, Engl ac Pitman & sons Ltd., London 1995	ish Language Book society &
4. <u>https:</u>	//nptel.ac.in/courses/108105131	
5. <u>https</u> :	//onlinecourses.nptel.ac.in/noc22_ee111/preview	

СС	OURSE	CODE:				COL	JRSE TI	TLE:			L	Т	Р	С	
1	0211E	E112		MICRO	DPROC	ESSOR	AND M	ICROC	ONTRO	LLERS	3 0 0				
COURS	E CATE	GORY:	Progra	mme C	Core										
PREAM and Mi on arch	I BLE: T crocon iitectur	he Pur troller. e, Prog	pose of To solv grammi	f the co ve real ng and	ourse is world system	s to pro probler n design	ovide st ns in ar n used i	udents n efficie n vario	s with t ent mar us day	the kno nner an to day	wledge d this o gadget	e of Mi course s.	croproo also en	cessors ophasis	
PRE-RE	QUISIT	e cou	RSES: D	Digital E	lectror	nics									
RELATE	D COU	RSES:	Embed	lded Sy	stem D	esign a	nd Eml	bedded	Proces	ssors.					
COURS The obj	E EDUC jectives Under	CATION s of the stand	IAL OB course the inte	IECTIVE are to ernal or	E S: , ganiza ⁻	tion, ac	ldressir	ng mod	es and	instruc	tion se	ts of 80)85 pro	cessor.	
٠	Famili	ar with	the va	rious fu	unction	al unit	s of 805	51 micr	ocontro	oller.					
•	Const addre	ruct an ssing m	embe nodes.	dded C	and as	sembly	y langu	age pro	ogram	by usin	g 8051	Instru	ction se	ets and	
٠	Under	stand	8085 pe	eripher	al devi	ces suc	h as 82	55, 827	'9, 825:	1, 8253	, 8259	and 82	37.		
•	Study proce	the ssors li	microco ke PIC,	ontrolle ARM a	er-base nd ATN	d syst 1EGA.	em de	esign f	or var	ious a	pplicat	ions a	nd ad [,]	vanced	
COURS	E OUT(on the	COMES succes	: sful cor	npletio	n of th	e cours	e, stud	ents wi	ll be at	ole to:					
CO Nos.				(Course	Outcor	nes				K (B Blo	nowled ased o om's T	lge Lev n revise axonor	el ed ny)	
C01	Dev org	/elop anizati	an ALP on for t	in 80 the give)85 mi en spec	cropro ificatio	cessor n	using	the in	ternal		к	3		
CO2	Exp 825	lain th 59 and	e perip 8237.	herals	device	s such a	as 8255	, 8279,	8251,	8253,		K	2		
CO3	Des mic	scribe crocont	the roller	archite	ecture	and f	unctior	al blo	ck of	8051		к	2		
CO4	Dev the	velop a intern	n emb al func	edded (tional b	C and A locks f	ALP in 8 or the §	3051 m given sp	icrocor pecifica	ntroller tion	using		K	3		
CO5	Exp PIC	lain m , ARM	icrocon and AT	troller MEGA	applica proces:	itions a sors.	nd basi	c archi	tecture	of		K	2		
CORRE	LATION	I OF CO	Ds WITH	H POs A	AND PS	Os									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	Н	Μ	М	L	М						М	L	Н	М	

CO3

CO4

CO5

Н

Н

Н

Μ

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М

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Μ

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М

COURSE CON	TENT:	
UNIT I	8085 MICROPROCESSOR	9
8085 Archited Addressing m processors.	cture – Pin diagram-Memory interfacing – I/O interfacing- Timing nodes – Assembly language programming- comparison of 8 bit	g Diagram- Instruction Set- (8085) and 16 bit (8086)
UNIT II	8085 MICROPROCESSOR PERIPHERAL DEVICES	9
Parallel perip USART (8251	heral Interface (8255) - Timer / Counter (8253) - Keyboard and - Interrupt Controller (8259) - DMA Controller (8237).	Display Controller (8279) -
UNIT III	8051 MICROCONTROLLER	9
Architecture Interfacing of	 memory organization –I/O ports and circuits-Timers - Interrup External Memory-Interfacing LCD & Keyboard-RTC. 	ts –serial communication -
UNIT IV	8051 MICROCONTROLLER PROGRAMMING	9
Addressing r Counter Prog	nodes -instruction set -Assembly language programming an ramming – Serial Communication Programming- Interrupt Programming – Serial Communication Programming – Seria	d C Programming–Timer amming.
UNIT V	APPLICATIONS OF MICROCONTROLLERS	9
Temperature Data Acquisit	control system - Motor speed control system – Traffic light Sy ions system - Introduction to architecture of PIC, ARM, ATMEGA	ystem – Elevator system - processors.
		TOTAL: 45 PEROIDS
TEXT BOOKS		
1. Rame Editio	esh S Gaonkar, 'Microprocessor Architecture, Programming and a on, Penram International Publishing.	Application with 8085', 6 th
2. Muha and E	ammad Ali Mazidi, Janice GillispieMazidi and Rolin D McKinlay, mbedded Systems using Assembly and C', 2 nd Edition Pearson ec	'The 8051 Microcontroller ducation Asia.
REFERENCE B	OOKS:	
1. Moha Editio	amed Rafiquzzaman, 'Microprocessor and Microcomputer Ba on, CRC press	ased System Design', 2 nd
2. Kenn 3 rd Ed	eth J Ayala, 'The 8051 Microcontroller Architecture Progra ition, Penram International Publishers.	mming and Application',
3. A.K Progr	Ray & K.M. Burchandi, 'Advanced Microprocessor and F ramming and interfacing ', 2 nd Edition, Tata McGraw-Hill.	Peripherals Architectures,
4. <u>http</u>	://nptel.ac.in/courses/108105102	

COURSE	CODE:			L	Т	P	C
				3	0	0	3
COURSE CAT	EGORT: PTO						
PREAMBLE: 1 discrete com integrated cir	This course g ponents suc rcuits.	ives a comprehensive exposure to all types of amplifien h as BJTs and FETs. Also, helps to develop a strong ba	s and oscillato sis for building	rs co lin	nstru ear a	cted nd di	with gital
PREREQUISIT	E COURSES:	Basic Electronics and Measurement Engineering					
RELATED CO	URSES: Line	ar Integrated Circuits, Digital Electronics					
COURSE EDU	CATIONAL C	DBJECTIVES:					
The objective	s of the cou	rse are to:					
 Designation 	n amplifier a	and oscillator circuits.					
 Class 	ify and analy	ze power amplifier circuits.					
 Under 	erstand the c	oncept of feedback amplifiers and its topologies					
• Unde	erstand the	operation of pulse circuits					
COURSE OUT	COMES:						
Upon the	successful o	completion of the course, students will be able to:					
CO Nos.		Course Outcomes	Knowledge L on revised Taxon	evel I Blo omy	(Bas om's)	ed	
CO1	Design BJT	and FET amplifier and oscillator circuits.	ĸ	2			
CO2	Analyze tr	ansistorized amplifier and oscillator circuits.	K	4			
CO3	Understan topologies	d the concept of feedback amplifiers and its	K	1			
CO4	Understan	d the applications of different oscillator circuits	K	2			
CO5	Analyze th circuits.	e working of attenuator, oscillator and multivibrator	K	4			
CORRELATIO	N OF COs W	ITH POs AND PSOs					

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	L								L	Н	М
CO2	Н	М	М	М								L	Н	М
CO3	Н	М	М	М								L	Н	М
CO4	Н	М	М	М								L	Н	М
CO5	Н	М	М									L	Н	М

COURSE C	ONTENT:	
UNIT I	SMALL SIGNAL AMPLIFIERS	9
Biasing ci amplifiers	rcuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers, of case studies – application of current amplifiers in SCR firing circuits and power suppli	chopper stabilized
UNIT II	LARGE SIGNAL AMPLIFIERS	9
Power am amplifiers	plifiers- classification, analysis and design of class A and class B power amplifiers, o , thermal considerations, tuned amplifiers.	class C and class D
UNIT III	FEEDBACK AMPLIFIERS	9
Basic cond input and in dc-dc co	cept of feedback amplifiers, effect of negative feedback on gain, gain stability, distored output impedances; topologies of feedback amplifiers, case studies – application of powerters.	ortion, bandwidth, negative feedback
UNIT IV	OSCILLATORS	9
Barkhause oscillators	en criterion for oscillation – Hartley & Colpitt's oscillators – RC phase shift, Wien - Clapp oscillator – oscillator amplitude stabilization.	bridge and crystal
UNIT V	PULSE CIRCUITS	9
Attenuato Trigger- U circuits.	rs – RC integrator and differentiator circuits – diode clampers and clippers –multiv JT Oscillator, case studies – application of UJT oscillator in SCR firing circuits and opto	/ibrators - Schmitt -electronic control
	Т	OTAL: 45 PERIODS
TEXT BOO	KS:	
1. Ja	cob Millman, 'Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009.	
2. Da 20	avid A Bell, 'Fundamentals of Electronic Devices and Circuits', Oxford University Pr 009.	ess, Incorporated,
REFERENC	E BOOKS:	
1. Al	len Mottershead, 'Electronic Devices and Circuits-An Introduction', PHI, 18th Reprint,	2006.
2. Tł	iomas L. Floyd, David M. Buchla, 'Electronics Fundamentals', Pearson Prentice Hall, 7t	h Edition, 2010.
3. Ro	obert.L.Boylestad, 'Electronic Devices and Circuit Theory', Pearson, 10th Edition, 2009.	
4. Se	dra Smith, 'Microelectronic Circuits', Oxford University Press, 6th Edition, 2010.	
5. Ja 2r	cob Millman and Christos C. Halkias, 'Integrated Electronics: Analog and Digital Circ nd Edition, Tata McGraw Hill Education, 2011.	uits and Systems',
6. <u>h</u> t	tps://nptel.ac.in/courses/108105158	

				1	1	
CO	URSE CODE:	COURSE TITLE:	L	Т	Р	С
10	0211EE114	LINEAR INTEGRATED CIRCUITS	3	0	0	3
COURSI	E CATEGORY: Prog	gramme Core				
PREAM	BLE: Linear Integra	ated Circuits introduces the basic concepts of Integrate	d circuits	along v	vith	
fundam	ental concepts of	electronic circuits like operational amplifiers, rectifiers	& timers	1		
PREREC	UISITE COURSES:	Basic Electronics and Measurement Engineering, Electronics	ronic Circ	uits		
RELATE	D COURSES: Circu	it Analysis				
COURSI	E EDUCATIONAL C	DBJECTIVES:				
The obj	ectives of the cou	rse are to,				
•	Familiar in the op	erational amplifier principle, analysis, design with its ap	oplication	s.		
•	Illustrate the lines	ar and nonlinear applications of operational amplifiers.				
•	Understand the o	perating principles of PLL.				
•	Familiar in the op	eration of ADC, DAC and its classifications.				
•	Understand the a	pplications of specific ICs.				
COURSI	E OUTCOMES:					
Upo	on the successful o	completion of the course, students will be able to:				
со			Level o	f learni	ng dom	nain
Nos.		Course Outcomes	(Ba	sed on Bloom	revised 's)	
C01	Construct the el given specificati	ectronic circuits using Operational Amplifier for the ons.		К3		
CO2	Explain the linea including compa	ar and nonlinear applications of Operational Amplifier arators and waveform generators.		К2		
CO3	Summarize the o	operating principle of PLL and its applications.		K2		
CO4	Illustrate the co	nstruction, types and operation of ADC / DAC.		К2		
CO5	Explain the appl Regulators, 555	ications of special function IC's such as voltage Timer.		К2		

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	L	L								Н	
CO2	Н	М	М	М	L								Н	
CO3	Н	М	М	М	L								Н	
CO4	Н	М	М	М	L						L		Н	
CO5	Н	М	М		L						L	М	Н	М

COURSE C	ONTENT:	
UNIT I	INTRODUCTION TO OPERATIONAL AMPLIFIERS	12
BJT differe load - cur represent Frequency filter	ential amplifier - Concept of CMRR - methods to improve CMRR - constant rent mirror - Darlington pair differential input impedance - The Ideal Op ation of Op Amp Voltage Transfer Curve of Op Amp - DC and AC Character Response - Slew Rate. Active Filters: Low pass, High Pass and band pass filter	current source - active Amp - Block diagram eristics of an Op Amp - ers - Switched capacitor
UNIT II	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9
Linear Application converter	olications: Inverting and Non inverting Amplifiers – Differentiator – Integration - Integration - Integration - Instrumentation amplifier	tor - Voltage to current
Non-Linea	r Applications: Clippers and Clampers - Precision rectifier - Log and Antilog a	mplifiers
Comparat Monstable	ors and Wave form Generators: Comparator - Regenerative comparator – A e Multivibrators - Triangular wave generator - Sine wave generators.	Astable Multivibrators –
UNIT III	PLL	6
Voltage Co	ontrolled Oscillator- Closed loop analysis of PLL – PLL Applications - Frequenc	y synthesizers.
UNIT IV	ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS	9
Analog sw Current d approxima	vitches - High speed sample and hold circuits and sample and hold ICs - Ty riven DAC - Switches for DAC- A/D converter Flash - Single slope - D ation - Delta Sigma Modulation - Voltage to Time converters.	pes of D/A converter - pual slope - Successive
UNIT V	SPECIAL FUNCTION ICs	9
555 Timer and switcl op-amp.	: Astable and Monostable Multivibrators, Schmitt trigger Voltage regulator ned mode types - Frequency to Voltage converters - Tuned amplifiers - Vide	rs using op-amp - linear o amplifiers - ECG using
		TOTAL: 45 PERIODS
TEXT BOO	KS:	
1. D. 20	Roy Choudhry and Shail B. Jain, "Linear Integrated Circuits"- (d/e), New Age 011.	International Pvt. Ltd,
2. 2. (d	R. Gayakwad, Op-amps and Linear Integrated Circuits (d/e), PHID. A. Bell, So /e), PHI, 2009.	lid state Pulse Circuits
REFERENC	E BOOKS:	
1. S.	Franco, Design with Operational Amplifiers and Analog Integrated Circuits (c	:/e) TMH, 2003.
2. R.	F. Coughlin & F. F. Driscoll: Operational Amplifiers and Linear Integrated circ	uits, PHI, 1996.
3. D.	A. Bell: Solid State pulse circuits, (d/e), PHI. Milman Gravel: Micro-Electronic	cs, McGraw Hill, 1999.
4. <u>ht</u>	tps://nptel.ac.in/courses/108105158	

COURSE CODE:	COURSE TITLE:		Т	Ρ	С
10211EE115	PROTECTION AND SWITCH GEAR	3	0	0	3

COURSE CATEGORY: Programme Core

PREAMBLE: The functioning of a power system depends significantly on efficient and reliable protection schemes. This course covers a refreshed pedagogy of Power System Protection and Switchgear technology covering the contemporary protection system, relay & breaker principles, types, operations and applications.

PREREQUISITE COURSES: DC Machines and Transformer, Transmission and Distribution

RELATED COURSES: Nil

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the essential qualities of a reliable protective system and protection terminologies
- Explain the operating principles of various relays based upon technology and functional requirements
- Understand Protection of electrical power apparatus generation, transmission and distribution system
- Understand the arcing phenomena, arc quenching and breaking in circuit breakers
- Classify different circuit breaker principles and operation

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	List out essential qualities of a protective system and protection terminologies.	К2
CO2	Understand the operating principles of electromagnetic relays.	К2
CO3	Understand the concept of microprocessor based numerical protective relays	К2
CO4	Summarize protection schemes for generation, transmission and distribution system	К2
CO5	Explain the principle of different Circuit breakers and its operation	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L											Н	
CO2	Н	L	L		L	L	L					L	Н	L
CO3	Н	L	L		Н	L	L					L	Н	L
CO4	Н	L	L		L	L	L					L	Н	L
CO5	Н	L	L			L	L					L	Н	L

COURSE CO	ONTENT:	
UNIT I	INTRODUCTION	9
Basic idea protective	s of short circuit currents and relay protection - basic terminology - essent relay - The universal relay - torque equation, RX diagram - CT, PT & applications	tial qualities of a
UNIT II	ELECTROMAGNETIC RELAYS	9
Electromag distance re	gnetic relays–operating principles of relays-Over current relays –directional over elays - differential relays - under frequency and negative sequence relays - mho re	er current relays - elay
UNIT III	MICROPROCESSOR BASED NUMERICAL RELAYS	9
Introductio Overcurrer	on- IC elements and circuits for interfaces – A/D converter, Analog multig nt relays-Impedance relay-Directional relay- Reactance relay- Mho relay.	olier, S/H circuit-
UNIT IV	PROTECTION OF POWER APPARATUS	9
Generator protection	protection - Transformer protection – Bus bar protection - Feeder protect and protection of transmission lines - Relay coordination of a sample system	ion - A.C. Motor
UNIT V	CIRCUIT BREAKERS	9
Arcing phe current br Vacuum ar	enomena and arc quenching - circuit breaker rating– RRRV - Current Choppir eaking – Construction and operation: Oil minimum circuit breakers, Air blast nd SF6 circuit breakers.	ng and Capacitive circuit breakers,
	тс	OTAL: 45 PERIODS
TEXT BOO	KS:	
1. B.F 19	Ravindranath and N.Chander, "Power Systems Protection and Switchgear", W 77.	Viley Eastern Ltd,
2. Ba Pu	dri Ram and Viswakarma, D.N., "Power System Protection and Switch Gear", blishing Company Ltd., 2001.	Tata McGraw-Hill
REFERENC	E BOOKS:	
1. C.I	Wadhwa, "Electric Power Systems", New Age International (P) Ltd publishers, 1	983.
2. S.F 19	P.Patra, S.K.Babu and S.Choudhuri, "Power Systems Protection", Oxford and IB 83.	M Publishing Co.,
3. Su	nil S. Rao, "Switchgear and protection", Khanna publishers, New Delhi, 1986.	
4. Lev 19	wis Blackburn "Protective Relaying – Principles and Applications", Second Edi 98.	tion, Dekker Inc.,
5. T.S	.MadhavaRao, "Power System Protection Static Relays", Second Edition, Tata Mo	cGraw Hill, 2004
6. <u>ht</u> t	ps://nptel.ac.in/courses/117107148	

INTEGRATED COURSE

COL	JRSE	CODE:	COURSE TITLE:								L T P C							
10	211E	E201				ELECTR	OMAG	NETIC	FIELDS		2 0 2							
COUR	RSE C	ATEGOR	Y: Prog	ramme	e Core													
PREA electr	MBL ostat	E: The pu tics, mag	irpose neto st	of this atics, a	course nd elec	is to pr ctroma	rovide s gnetic v	student waves.	s with a	an intro	duction t	o the fu	undar	nent	tals of			
PRER	EQUI	SITE CO	JRSES:	Engine	ering P	hysics												
RELA	TED (COURSES	: AC M	achine	s, Speci	ial Elect	trical N	1achine	S									
COUR	RSE E	DUCATIO	ONAL O	BJECTI	VES:													
The o	bject	ives of t	ne cour	rse are	to,													
•	Ur m:	nderstan	d the fu	undame tored e	ental na	ature o	f static Indary	electri	c fields, ons	potenti	al, flux, c	harge c	lensit	ies,	static			
•	Im	ipart Kno	wledge	e on the	e Basic	laws th	nat are	govern	ing the	electror	nagnetic	fields.						
•	 Introduce the concepts of electromagnetic waves and its sources 																	
COURSE OUTCOMES:																		
Upon	thes	successfi	ul comp	oletion	of the o	course,	studer	nts will	be able	to:								
CO Nos					Course	Outco	mes				Knowle revised	edge Le I Bloom	vel (E 's Ta	Base konc	d on omy)			
CO1	. 6	Explain a	bout el	ectrost	atics ar	nd sour	ces of	electric	fields			K	2					
CO2		Apply the	e know	knowledge of electrostatics for dielectric study								K	3					
CO3	E	Explain a	bout m	agneto	statics	and so	urces c	of magn	etic fiel	ds		K	2					
CO4	. r	Make use	e of Finite Element Method to solve field Equations									K	3					
CO5	E	Explain a and lossle	ibout E ess diel	Electror ectrics	nagnet and the	ic wav eir imp	es in i ortance	n free e	space,	lossy		K	2					
CORR			COs WI	TH PO	s AND I	PSOs												
COs	PO	1 PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSC	01	PSO2			
CO1	н	н	L		М				<u> </u>				н	\uparrow				
CO2	н	н	L		М								н	\uparrow				
CO3	н	н	L		М								н					

CO4

CO5

Н

Н

Н

Н

L

L

Н

Н

COURS	CONTENT:	
UNIT I	ELECTROSTATICS-I	9
Sources Curl – t	and effects of electromagnetic fields – Coordinate Systems – Vector fields – neorems and applications - Coulomb's Law – Electric field intensity – Gauss's la	Gradient, Divergence, aw and applications.
UNIT I	ELECTROSTATICS-II	9
Electric — Elect Bounda	potential – Electric field and equipotential plots, Uniform and Non-Uniform firc field in free space, conductors, dielectrics - Dielectric polarization – I ry conditions, Poisson's and Laplace's equations - Applications.	eld, Utilization factor Dielectric strength –
UNIT I	I MAGNETOSTATICS	9
Lorentz conduc - magne	force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Lav ors - circular loop, infinite sheet of current - Magnetic flux density (B) – B in f tic materials – Magnetization– Boundary conditions - Poisson's Equation - App	v – H due to straight ree space, conductor plications
UNIT IV	ELECTRODYNAMIC FIELDS AND SOLUTION OF FIELD EQUATIONS (FEM)	9
Magnet equatio Applica	ic Circuits - Faraday's law – Transformer and motional EMF – Displacemen ns (differential and integral form) – Relation between field theory au tions.	t current -Maxwell's nd circuit theory —
UNIT V	ELECTROMAGNETIC WAVES	9
Electroi propaga Poyntin	nagnetic wave generation and equations – Wave parameters; velocity, ition constant – Waves in free space, lossy and lossless dielectrics, condu g vector, Application	intrinsic impedance, actors - skin depth -
		TOTAL: 45 PERIODS
LIST OF	EXPERIMENTS (15 PERIODS)	
1. 2. 3. 4. 5. 6. 7.	Plotting of vectors using mathematical development tool Computation and plotting of curl fields using mathematical development tool Computation and plotting of gradient and divergence fields using mathematical of Coulombs law with two charged objects Electromagnetic Induction Charged particle in magnetic field Study of Force acting on the conductor in DC motor	levelopment tool
8. 9. 10.	Computation of electric field intensity, voltage distribution and capacitance using Computation of magnetic field intensity, inductance and force using FEM/FDM packages Calculation of skin depth using FEM/FDM packages	FEM/FDM packages ackages
1.	Mathew N. O. Sadiku, 'Principles of Electromagnetics', 4 th Edition, Oxford Univ	versity Press In3.First
2.	India edition, 2009. Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Lear New Delhi, Second Edition-2009.	ning Private Limited,
REFERE	NCE BOOKS:	
1.	Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition	n (Schaum's Outline
2.	Series), Tata McGraw Hill, 2010 William H. Hayt and John 1. Buck, 'Engineering Electromagnetics', Tata McC edition. 2011.	Graw Hill 8 th Revised
3.	Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill Interna Edition, 2010.	tional Editions, Fifth
4.	D. K. Cheng, Field and Wave Electromagnetics, Addison-Wesley, 1992	

LABORATORY COURSES

		0005													<u> </u>	
	URSE	CODE:				COL	JRSE TI	TLE:					- Р		L	
10	0211	E301			CIR		AND DE	VICES I	.AB		0	0	2		1	
COURS	SE CA	FEGORY :	Progra	imme C	ore											
PREAN	/IBLE:	This cou	rse aim	ns to m	ake the	e stude	nts ver	ify netv	vork th	eorem	s practi	cally a	nd und	ersta	and	
circuits	s witl	h three	phase,	and tr	ansien	ts. It is	s also a	aimed	to gaiı	n know	ledge	on cha	aracteri	stics	; of	
electro	onic d	evices.														
PRERE	QUIS	TE COUF	RSES: Ba	asic Ele	ctronic	s and N	Aeasur	ement	Engine	ering						
RELAT	ED CC	URSES:	Control	and In	strume	entatior	n Lab, P	ower E	lectror	nics Lab						
COURS	SE ED	JCATION	IAL OB.	JECTIVE	ES:											
The ob	Jectiv	es of the	course	e are to	,											
•	Veri	fy the ne	twork	theorer	ns											
•	Und	erstand	the imp	portanc	e of tw	o port	networ	⁻ k parar	neters							
•	Und	erstand	the cha	racteri	stics of	variou	s electr	onic de	evices.							
COURS	SE OU	TCOMES	:													
Upon t	the su	ccessful	comple	etion of	the co	urse, st	tudents	s will be	able t	0:						
со				Cou	rse Ou	tcomes	5			Kno	owledg	e Leve	l (Base	d on	i	
Nos	•	revised Bloom's Taxonomy)														
CO1	L	Execute	and vei	d verify network theorems						K3, S2						
CO2	2	Build the	e two p	o port networks							K3, S2	2				
CO3	3	Perform	power	measu	remen	t in eleo	ctrical s	system				K3, S2	<u>)</u>			
CO4	Ļ	Perform	charac	teristic	s of PN	junctio	on diod	e and B	JT			K3, S2	2			
	-	Demons	trate tl	he V-I	charac	teristic	s of U	IT, JFET	and							
CO5	>	MOSFET										K3, S2	<u>)</u>			
CORRE		ON OF CO	Ds WITI	H POs A	AND PS	Os										
600		003	000	004	DOF	DOC	007	DO0	DO0	0010	0011	DO13	DC 01	DC	~	
COs	PO.	. PO2	PO3	P04	P05	P06	P07	P08	P09	PO10	P011	P012	PS01	420	UZ	
CO1	H	H	M	M	L				M			L	M		1	
CO2	H	<u> H</u>	M	M	L				M			L	M		1	
03	н	н	IVI	IVI	L				IVI	L		L	IVI	- F	1	
CO4	H	H	M	M	L				IVI	L		L	M		1	
CO5	H	H	Μ	Μ	L				Μ	L		L	Μ	ŀ	1	
LIST O	F EXP	ERIMEN	rs:													
							Cir	cuits								
1.	Veri	fication of	of Thev	enin's t	heorer	n.										
2.	Veri	fication of	of Supe	rpositio	on theo	orem.										
3.	Mea	sureme	nt of tw	o port	netwo	rk para	meters									
4.	Trar	sient res	sponse	of serie	es RL ar	nd RC c	ircuits.									
5.	Pow	er and p	ower fa	actor m	easure	ment b	y two v	wattme	ter me	thod.						
		•					Dev	vices								

- 6. V-I characteristics of PN junction diode.
- 7. Characteristics of Common Emitter Configuration of Transistor
- 8. Characteristics of MOSFET
- 9. Characteristics of UJT
- 10. Characteristics of JFET

COU	RSE CODE:	COURSE TITLE:	L	Т	Р	C
102	211EE302	DC MACHINES & TRANSFORMERS LAB	0	0	2	1
COURSE	CATEGORY: Pro	ogramme Core	I			
PREAMB and oper	LE: The course n circuit charact	provides an introduction to DC machines and trans eristics DC machines and transformers.	sformers	. It dea	als wit	h loa
PREREQU	UISITE COURSES	Basic Electrical & Electronics Engineering Lab				
RELATED	COURSES: Soli	d State Drives, AC Machines, Linear Control Systems,	, Special I	Electric	al Ma	chine
The obje • E • E	ctives of the contexpose the stue experimental sk	urse are to, udent for the operation of DC machines and ills	Transfori	mers a	and p	rovio
Upor	n the successful	completion of the course, students will be able to:				
CO Nos.		Course Outcomes	Knowle on re T	dge Le vised I axono	vel (Ba Bloom my)	ised 's
CO1	Perform the o	haracteristic study of DC Shunt Generator		K3, S	3	
CO2	Perform the o	haracteristic study of DC compound machines		K3, S	3	
CO2 CO3	Perform the o	characteristic study of DC compound machines oad characteristic of DC motors.		КЗ, S КЗ, S	3	
CO2 CO3 CO4	Perform the of Perform the I Demonstrate perform the machines	characteristic study of DC compound machines oad characteristic of DC motors. speed control methods for DC motors and also Swinburne's test to find the efficiency of DC		КЗ, S КЗ, S КЗ, S	3 3 3	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н		М					М	L		L	Н	М
CO2	Н	Н		М	L				М	L			Н	М
CO3	Н	Н		М	L				М	L			Н	М
CO4	Н	Н		М	L				М	L		L	Н	М
CO5	Н	Н		М					М	L			Н	М

- 1. Open circuit and load characteristics of D.C separately excited shunt generator
- 2. Open circuit and load characteristics of D.C self-excited shunt generator
- 3. Load characteristics of D.C. compound generator with differential and cumulative connection.
- 4. Load characteristics of DC compound motor
- 5. Load characteristics of D.C shunt motor
- 6. Load characteristics of D.C series motor
- 7. Swinburne's test in DC machine
- 8. Speed control of D.C shunt motor
- 9. Open circuit and short circuit tests on single phase Transformer
- 10. Load test on three phase Transformer
- 11. Study of DC Motor Starters

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10211EE303	AC MACHINES LAB	0	0	2	1

COURSE CATEGORY: Programme Core

PREAMBLE: The course provides the information to obtain the various performance characteristics of Three phase induction motors, single phase induction motors and synchronous machines by conducting different test methods. It also gives the information on speed control of slip ring induction motor.

PREREQUISITE COURSES: DC Machines and Transformer

RELATED COURSES: Solid State Drives, Special Electrical Machines

COURSE EDUCATIONAL OBJECTIVES:

The objective of the course is to,

• Understand the various performance characteristics of Induction motors and Synchronous machines.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Perform OC and SC tests on three phase Alternator to determine regulation using EMF, MMF, ZPF and slip test methods.	K3, S2
CO2	Execute load test on Synchronous motor for identifying V and inverted V curves.	K3, S2
CO3	Perform OC and SC tests on three phase Induction motor for identifying performance characteristics through circle diagram.	K3, S2
CO4	Build the equivalent circuit parameters of Induction motors using No load test and Blocked rotor test.	K3, S2
CO5	Execute speed control in slip ring induction motor.	K3, S2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н		М					М	L			Н	L
CO2	Н	Н		М					М	L			Н	L
CO3	Н	Н		М					М	L			Н	L
CO4	Н	Н		М					М	L			Н	L
CO5	Н	Н		М	L				М	L			Н	L

- 1. Determination of voltage regulation of three phase alternator by EMF and MMF methods
- 2. Determination of voltage Regulation of three phase alternator by ZPF method
- 3. V and Inverted V curves of three phase synchronous motor
- 4. Load test on three-phase induction motor
- 5. Determination of equivalent circuit parameters of three phase induction motor
- 6. Predetermine the performance characteristics of three phase induction motor using circle diagram
- 7. Speed control of three phase slip ring induction motor
- 8. Load test on single-phase induction motor
- 9. No load and blocked rotor test on single-phase induction motor
- 10. Study of induction motor starters.

COL	JRSE CODE:	COURSE TITLE:	L	Т	Р	С
10	211EE304	CONTROL & INSTRUMENTATION LAB	0	0	2	1
COURSE	CATEGORY: Progr	ramme Core			•	
PREAMB measure	LE: The aim of the ment of different	nis lab is to fortify the students with an adequ quantities and also the expertise in Digital simula	ate wor tion of s	k expe systems	erience s	in the
PREREQ	JISITE COURSES: (Circuit Analysis Lab				
RELATED	COURSES: DC Ma	achines & Transformers Lab				
COURSE	EDUCATIONAL OI	BJECTIVES:				
The obje	ctives of the cours	se are to,				
•	 Done the Mea Give exposure Design the cor Determine the 	surement of displacement, resistance, inductance to AC, DC bridges measurement. npensators. transfer function of Electrical Machines.	e, torque	e and a	ngle	
COURSE	OUTCOMES: hthe successful co	mpletion of the course, students will be able to:				
CO Nos.		Course Outcomes	Knowl on	ledge L revised Taxon	evel (B l Bloom omy)	ased I's
C01	Demonstrate th	e transfer function of Electrical Machines		КЗ,	S3	
CO2	Execute the des	ign of first and second order and compensators		КЗ,	S2	
CO3	Perform measur and frequency of	rement of phase difference, voltage, current of an input signal		КЗ,	S2	
CO4	Perform the me AC bridges	asurement of circuit parameters using DC and		КЗ,	S2	
CO5	Perform the me	asurement of BH curve using solenoid		КЗ,	S2	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	М	М				М	L	L	L	Н	М
CO2	Н	Н	М	М	М				М	L	L	L	Н	М
CO3	Н	Н		М	L				М	L		L	Н	М
CO4	Н	Н	М	М	L				М	L		L	Н	М
CO5	Н	Н		М	L				М	L		L	Н	М

- 1. Design of P, PI and PID controller
- 2. Synchro-Transmitter- Receiver and Characteristics
- 3. Determination of transfer function of DC servo motor
- 4. Determination of transfer function of AC servo motor
- 5. Design of Lag, Lead and Lag-Lead Compensators
- 6. Bridge Networks –AC and DC Bridges
- 7. Dynamics of Sensors/Transducers
 - a. Temperature
 - b. Pressure
 - c. Displacement
 - d. Optical
 - e. Strain
 - f. Flow
- 8. Instrumentation Amplifier
- 9. Analog to digital and Digital to analog converter
- 10. Inverting, Non-Inverting and Differential Amplifiers Using Op-Amp

CO	URSE (ODE:				COL	JRSE TI	TLE:			I	. Т	Р	С			
10	D211EE	305		MICRO	PROCE	SSOR 8	& MICR	OCON	FROLLE	RS LAB	6 () 0	2	1			
COURS	E CATI	GORY:	Progra	amme (Core												
PREAM their k provide help th techno	IBLE: Nanowle es hand he stu logies.	Aicropr dge or ds-on e dents	ocesso proce xperie do th	ers and essor a nce to eir pro	Micro archited interfa ojects	control cture a ice I/O and er	llers lal and the device nhance	oorator e prog s. The their	ry cour rammi skills a knowl	se help ng skil ncquire ledge o	os the ls. Thi d throu on the	studen s labo ugh the lates	ts to d ratory e exper t trenc	evelop course iments ls and			
PREREC	QUISIT	E COUF	RSES: E	lectron	ic Devi	ces & C	Circuits	Lab.									
RELATE	D COL	O COURSES: Project Work															
COURS	E EDU	CATION	IAL OB	JECTIV	ES:												
The ob	jective	s of the	course	e are to),												
•	Give l	nands o	on expe	rience	in 8085	5 assen	nbly lar	iguage	progra	mming							
•	Give l	nands o	on expe	rience	in perij	pheral	interfa	cing wit	th 8085	5 and 8	051.	51.					
•	Intro	duce 80	51 mic	rocont	roller p	rogram	nming.										
COURS	E OUT	COMES	:														
Up	on the	succes	sful co	mpletic	on of th	e cours	se, stuc	lents w	ill be a	ble to:							
CO Nos					Cour	se Out	comes					Level domai revise tax	of learr n (Base ed Bloo onomy	ning d on m's)			
CO1	D	emonst peratio	trate and	n asse code c	mbly la onversi	anguag ions us	e prog ing inst	rams f ructior	or all sets o	arithm f 8085.	etic	ł	<3 <i>,</i> S3				
CO2	P U	erform SART,	an ass ADC/D	embly AC, Ti	langua mer IC	ge prog & Key	gram fo vboard	or inter / Disp	facing lay Co	8085 w ntrolle	vith r).	ł	<2, S2				
CO3	B O in	emonst peratio structio	trate a ns, Ti on sets	n asse mers/C of 805	mbly la Countei 1.	anguag rs and	e prog d Inte	rams f rrupt	or all handli	arithm ing us	etic sing	ł	<3 <i>,</i> S3				
CO4	L Po	erform epper	an ass Motor,	embly DC Mc	langua otor, AE	ge prog DC/DAC	gram fo C, Matri	or inter x/Keyb	facing oard &	8051 w LCD.	vith	ł	<2, S2				
CO5	D 0 0	emonst peratio rocesso	rate a ns and r.	n asse code	mbly la conver	anguag sions (e prog using ii	rams f nstructi	or all ion set	arithm s of A	etic RM	ł	<3 <i>,</i> S3				
	ΙΑΤΙΟΙ	N OF CO	Ds WIT	H POs /	AND PS	SOs											
CORRE												1					
CORRE Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2			
CORRE Cos CO1	РО1 Н	PO2 M	РОЗ М	PO4 M	РО5 М	PO6	PO7	PO8	РО9 М	PO10 L	PO11 L	PO12	РSO1 Н	PSO2 M			

CO3

CO4

CO5

Н

Н

Μ

Μ

М

Μ

Μ

Assembly Language Programming With 8085:

- 1. Arithmetic Operations of two 8-bit numbers (Addition, Subtraction, Multiplication & Division).
- 2. Arranging an array of data (ascending order & descending order).
- 3. Code Conversion (BCD to HEX, HEX to BCD, HEX to ASCII & ASCII to HEX).
- 4. Interfacing (8251 (USART), ADC/DAC, 8253 (Timer IC) & 8279 (Keyboard/Display Controller).

Assembly Language Programming With 8051 Microcontroller:

- 5. Arithmetic Operations of two 8-bit numbers (Addition, Subtraction, Multiplication & Division).
- 6. Verify Timer/ Counter.
- 7. Verify Interrupt Handling.
- 8. Interfacing (Stepper Motor, DC Motor, ADC/DAC, Matrix/Keyboard & LCD).

Assembly Language Programming with ARM Processor:

- 9. Arithmetic Operations of two 8-bit numbers (Addition, Subtraction, Multiplication & Division).
- 10. Code Conversion.

CO	URSE (CODE:				COU	IRSE TI	TLE:			L T P C							
10	211EE	306		ANA	LOG A		GITAL E	LECTR	ONICS	LAB 0 0 2 1								
COURS	E CAT	EGORY	: Progra	amme	Core						I							
PREAM	1BLE: 1	This lab	helps	the stu	udents	to dev	elop th	neir kno	owledg	e on a	nalog a	ind dig	ital ele	ctronic				
circuits	s. The s	skills ga	ined th	rough	the ex	perime	nts wil	l help t	he stu	dents to	o do th	eir pro	jects.					
PRERE	QUISIT	E COU	RSES: E	Basic El	ectroni	cs and	Measu	iremen	it Engir	neering								
RELATE		JRSES:	Nil															
The ob	iective	canor es of the		e are to	0.													
•	Linde	rstand the operation of amplifier and oscillator circuits																
•	Unde	erstand the basic concepts of logic gates																
•	Desig	gn combinational circuits																
COURS		COMES	5:															
Upon t	he suc	cessful	compl	etion o	f the c	ourse,	studen	ts will l	be able	e to:								
со				Cou	rso Οιι	trome	c			Kno	owledg	e Leve	l (Base	d on				
Nos.				cou		come	5			revi	ised Bl	oom's	Taxono	omy)				
CO1	D	esign a	and ar	nalyze	the p	erform	ance d	of amp	olifier			V1 52						
	ci	rcuits										к4,35						
CO2	D	esign a	nd rea	lize the	o Scill	ator ci	rcuits					K4,S3						
CO3	U	ndersta	and the	e conce	ept of lo	ogic ga	tes					K1,S1						
604	U	ndersta	and ar	nd real	lize th	e com	binatio	nal cir	rcuits			K1 C1						
C04	u	sing log	gic gate	s								к1,51						
CO5	D	esign a	nd imp	lemen	t count	er circ	uits					K4,S3						
CORRE	LATIO	N OF C	Os WIT	'H POs	AND P	SOs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2				
CO1	Н	М	М	L					М	L			М	н				
CO2	Н	М	Μ	L					М	L			М	Н				
CO3	Н	М	М	L					Μ	L		L	М	Н				
CO4	Н	М	М	L					М	L L M H								
CO5	Н	Μ	Μ	L					Μ	L L M H								
LIST OF	EXPE	RIMEN	TS:															
	Anal	og Circ	uits:															
1.	Frequ	quency analysis of common emitter amplifier																
2.	Desig	n of Cla	ass B p	ower a	mplifie	rs	-											

- 3. Design and verification of RC phase shift oscillator
- 4. Design of UJT relaxation oscillator
- 5. Design and implementation of Astable Multivibrator using 555 timer IC Digital Circuits:
- 6. Realization of digital logic gates
- 7. Implementation of adder and subtractor circuits
- 8. Design and implementation of code converters using logic gates
- 9. Design of combinational circuits using multiplexer
- 10. Design and implementation of counters

COURSE	CODE:	COURSE TITLE:		L	Т	Р	С
10211E	E307	POWER ELECTRONICS LAB		0	0	2	1
COURSE CAT	EGORY: Pro	gramme Core				1	
PREAMBLE: *	This lab int rol DC moto	roduces the concept of power control and power ors and Induction motors.	cor	nver	sion te	chnique	es and
PREREQUISIT		Electronic Devices & Circuits Lab.					
RELATED CO	URSES: Pow	er System Simulation Lab.					
COURSE EDU	CATIONAL	OBJECTIVES:					
The objective	es of the cou	urse are to,					
 Make 	e the studer	nts aware of different power conversion techniques					
• Unde	erstand the	various control methods for machines					
COURSE OUT Upon the	COMES: successful	completion of the course, students will be able to:					
CO Nos.		Course Outcomes	Kn	now on	ledge L revised Taxon	evel (Ba Bloom omy)	ased 's
CO1	Sketch th devices.	e characteristics of various power switching			K2,	S2	
CO2	Demonstra three phas	te the concept of working of single phase and e rectifiers.			КЗ,	S3	
CO3	Show the single-phase inverters.	working of power circuit and control circuit of se half & full bridge inverters and three phase			КЗ,	\$3	
CO4	Accomplish with contro	n the task of implementing DC-DC converters			КЗ,	S3	
CO5	Demonstra converters	te the working of phase-controlled AC-AC .			КЗ,	S3	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	М		Μ	М							М	М		
CO2	н		Н	н		М					Н	Н	М	
CO3	М		М	М		М					М	М		
CO4	М	М		М		М			М		М	М		М
CO5	Н	Н	Н	Н		М			Н		Н	Н		

- 1. VI Characteristics of SCR, IGBT & MOSFET.
- 2. Single phase full converter feeding R, RL, RLE load.
- 3. Single phase semi converter feeding R, RL, RLE load.
- 4. Single phase dual converter.
- 5. MOSFET based step up and step-down chopper
- 6. IGBT based single phase PWM inverter.
- 7. Three phase IGBT based PWM inverter
- 8. Single phase AC voltage controller
- 9. Single phase cycloconverter
- 10. Three phase full converter.
- 11. Series resonant converter.

			1	1	1	
COL	JRSE CODE:	COURSE TITLE:	L	Т	Р	C
10	211EE308	POWER SYSTEM SIMULATION LAB	0	0	2	1
OURSE C	ATEGORY: Program	nme Core	·			
REAMBL	E: This course teac	hes Modelling of Transmission Lines, and Sol	ution of	Load Flo	ow analy	/sis
REREQU	ISITE COURSES: Cir	cuit Analysis Lab				
	COURSES: Power S	ystem Operation and Control				
OURSE E	DUCATIONAL OBJ	ECTIVES:				
he object	tives of the course	are to,				
• Ur	nderstand about tr	ansmission line parameters.				
• Fo	ormulate Z bus and	Y bus				
• De	evelop Load flow a	nalysis – GS and NR method				
• Co	onstruct suitable m	odel for load frequency control				
• Pe	erform Short circuit	analysis for the given power system networ	k			
• Sc	olve transient stabil	ity problem for the power system				
• Pla	an economic dispa	tch schedule for the given power system				
COURSE C	OUTCOMES:					
Upon	the successful com	pletion of the course, students will be able to	0:			
CO Nos.		Course Outcomes	Kno O	wledge n revise Taxo	Level (B d Bloon nomy)	lased n's
CO1	Perform the calcu	ulation for transmission line parameters		К2	, S2	
CO2	Build Z bus and Y	bus and perform load flow analysis		К2	, S2	
CO3	Perform Short cir	cuit analysis		К3	, S3	
CO4	Demonstrate loa	d frequency control on power system		K2	, S2	
CO5	Execute transient	t stability study		K2	, S2	
CO6	Perform Econom	ic dispatch schedule		K2	, S2	

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	L	Н				L	L	L	L	Н	М
CO2	Н	Н	М	L	Н				L	L	L	L	Н	М
CO3	Н	Н	М	L	Н	L			L	L	L	L	Н	М
CO4	Н	Н	М	L	Н	L			L	L	L	L	Н	М
CO5	Н	Н	М	L	Н	L			L	L	L		Н	Μ
CO 6	Н	Н	М	L	Н				L	L	L		Н	М

- 1. Calculation of transmission line parameters using MATLAB.
- 2. Voltage regulation and efficiency calculation of medium, long transmission line using MATLAB.
- 3. Formulation of Y bus and Z bus matrix using MATLAB.
- 4. Load flow analysis GS method using MATLAB.
- 5. Load flow analysis NR method using MATLAB.
- 6. Short circuit analysis on DC network analyzer.
- 7. Symmetrical component analyzer.
- 8. Transient stability analysis.
- 9. Load frequency control of single area and two area power system with MATLAB/Simulink.
- 10. Economic dispatch control using MATLAB.
- 11. Study of Microgrid

PROGRAMME ELECTIVE COURSES

List of Courses

S.NO.	COURSE CODE	COURSE NAME	L	т	Р	с
		POWER SYSTEMS DOMAIN				
1.	10212EE121	Power Quality Engineering	3	0	0	3
2.	10212EE122	High Voltage Engineering	3	0	0	3
3.	10212EE123	Advances in Power System	3	0	0	3
4.	10212EE124	Power Plant Engineering	3	0	0	3
5.	10212EE125	High Voltage Direct Current Transmission	3	0	0	3
6.	10212EE126	Load Forecasting and Generation Forecasting	3	0	0	3
7.	10212EE127	Load Dispatching	3	0	0	3
8.	10212EE128	Reactive Power Management	3	0	0	3
9.	10212EE129	Smart Grid	3	0	0	3
		POWER ELECTRONICS & DRIVES DOMAIN				
1.	10212EE130	Led Lighting Technology	3	0	0	3
2.	10212EE131	Flexible AC Transmission Systems	3	0	0	3
3.	10212EE132	Modern Power Converters	3	0	0	3
4.	10212EE133	Automotive Electrical and Electronics Systems	3	0	0	3
5.	10212EE134	Fundamentals of Electric and Hybrid Vehicles	3	0	0	3
6.	10212EE135	Special Electrical Machines	3	0	0	3
7.	10212EE136	Electromagnetic Interference and Compatibility	3	0	0	3
8.	10212EE137	Solid State Drives	3	0	0	3
	-	EMBEDDED SYSTEMS DOMAIN	-		_	-
1.	10212EE138	Principles of Robotics	3	0	0	3
2.	10212EE139	Embedded Systems	3	0	0	3
3.	10212EE140	Embedded Control of Electric Drives	3	0	0	3
4.	10212EE141	VLSI System and Design	3	0	0	3
5.	10212EE142	Wearable Electronics	3	0	0	3
	-	INSTRUMENTATION & CONTROL DOMAIN	-		_	-
1.	10212EE143	Virtual Instrumentation	3	0	0	3
2.	10212EE144	Digital Control Systems	3	0	0	3
3.	10212EE145	Introduction to Nonlinear Dynamical Systems	3	0	0	3
4.	10212EE146	Discrete Time Signal Processing	3	0	0	3
5.	10212EE147	Signals and Systems	3	0	0	3
6.	10212EE148	Soft Computing	3	0	0	3

S.NO.	COURSE CODE	COURSE NAME	L	т	Р	С
7.	10212EE149	Bio Medical Instrumentation	3	0	0	3
8.	10212EE150	Process Automation	3	0	0	3
		ENERGY DOMAIN				
1.	10212EE151	Utilization of Electrical Energy	3	0	0	3
2.	10212EE152	Energy Auditing and Management	3	0	0	3
3.	10212EE153	Electrical Safety and Safety Management	3	0	0	3
4.	10212EE154	Renewable Energy Sources	3	0	0	3
5.	10212EE155	Solar Electric Systems	3	0	0	3
6.	10212EE156	Wind Energy Conversion Systems	3	0	0	3
7.	10212EE157	Generation Planning	3	0	0	3
8.	10212EE158	Solar Photovoltaic Systems	3	0	0	3
		ELECTRONICS DOMAIN				
1.	10212EE159	Nano Electronics	3	0	0	3
2.	10212EE160	Green Electronics	3	0	0	3
3.	10212EE161	Automotive Electronics	3	0	0	3
4.	10212EE162	Vehicle Electronics	3	0	0	3
5.	10212EE163	Optoelectronic devices	3	0	0	3
6.	10212EE164	Electronic Circuit Simulation and PCB Design	3	0	0	3
7.	10212EE165	Medical Electronics	3	0	0	3
		INTEGRATED COURSES				
1.	10212EE201	Applied Soft Computing	2	0	2	3
2.	10212EE202	Switch Mode Power Supply Design and Development	2	0	2	3
3.	10212EE203	Electrical Machines	2	0	2	3
		LABORATORY COURSE				
1.	10212EE301	Voltage Stabilizer Fabrication	0	0	2	1

COURS	E CODE:	COURSE TITLE:	L	Т	Р	С						
10212	EE121	3	0	0	3							
COURSE CATEGORY: Programme Elective												
PREAMBLE: This course covers an introduction to power quality, voltage sags, overvoltage,												
harmonics	and power q	uality monitoring										
PREREQUIS	SITE COURSE	S: Power Electronics, Protection and Switchgear										
COURSE ED	OUCATIONAL	OBJECTIVES:										
The objecti	ives of the co	urse are to,										
• Un	Understand about basics of power system quality											
• Acc	quire knowle	dge in calculation of voltage sags and interruptions										
• Far	Familiar with overvoltage and its causes											
• Exp	olain about h	armonic distortion and its control										
 Understand the power quality monitoring and its equipments 												
COURSE O	UTCOMES:											
Upon t	he successfu	I completion of the course, students will be able to:										
со	Knowledge Level											

CO Nos.	Course Outcomes	(Based on revised Bloom's Taxonomy)
CO1	Explain about power system quality issues	К2
CO2	Calculate voltage sags and interruptions	К2
CO3	Have an insight on over voltages and its causes	К2
CO4	Explain about harmonic distortion and its control	К2
CO5	Illustrate the fundamentals of power quality monitoring and its equipments	К2

CORRELATION OF COs AND POs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Μ	L								L	Μ	Н	L
CO2	Н	Μ	L								L	Μ	Н	L
CO3	Н	Μ	L								L	Μ	Н	L
CO4	Н	Μ	L								L	М	Н	L
CO5	Н	М	L								L	М	Н	L

COURSE C	ONTENT:										
UNIT I	INTRODUCTION TO POWER QUALITY	9									
Terms and Waveform Manufact	d definitions – Overloading – Under voltage – Sustained Interru n distortion – Total Harmonic Distortion (THD) – Compute urers Associations (CBEMA) curve	ption-Sags and Swells – er Business Equipment									
UNIT II	UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9										
Sources of sags and interruptions – Estimating voltage sag performance – Motor starting sags – Estimating the sag severity – Mitigation of voltage sags – Active series compensators – Static transfer switches and fast transfer switches											
UNIT III	OVERVOLTAGES	9									
Sources of swells – S Line arres PSCAD and	Sources of over voltages – Capacitor switching – Lightning – Ferro resonance – Mitigation of voltage swells – Surge arresters – Low pass filters – Power conditioners – Lightning protection – Shielding – Line arresters – Protection of transformers and cables – Computer analysis tools for transients – PSCAD and EMTP										
UNIT IV	HARMONICS	9									
Harmonic commerci characteri distortion	Harmonic distortion – Voltage and current distortion – Harmonic indices – Harmonic sources from commercial and industrial loads – Locating harmonic sources – Power system response characteristics – Resonance – Harmonic distortion evaluation – Devices for controlling harmonic distortion – Passive filters – Active filters – IEEE and IEC standards										
UNIT V	POWER QUALITY MONITORING	9									
Monitoring considerations – Power line disturbance analyzer – Power quality measurement equipment – Harmonic / spectrum analyzer – Flicker meters – Disturbance analyzer – Applications of expert system for power quality monitoring											
		TOTAL: 45 PERIODS									
TEXT BOO	KS:										
1. M Pr	1. Math H.J.Bollen, 'Understanding Power Quality Problems-Voltage Sag & Interruptions', IEEE Press,2000										
2. Ro Sy	oger C. Dugan, Mark F. McGranagham, Surya Santoso and H.Wayne stems Quality', McGraw Hill, 2003.	Beaty, 'Electrical Power									
REFERENC	E BOOKS:										
1. Al	exander Kusko, Power Quality in Electrical Systems, McGraw-Hill, 2	007.									

COURSE CODE:	COURSE TITLE:	L	Т	Р	С					
10212EE122	HIGH VOLTAGE ENGINEERING	3	0	3						
COURSE CATEGORY: Programme Elective										
PREAMBLE: This course covers specifications of insulation materials in liquid, gas and solid case and identifies the effect of extra high voltage on the environment. This module will prepare students for effective participation in the field of high voltage power systems within the electrical engineering environment.										
PREREQUISITE COURSES: Power System Analysis, Power Electronics										

The objectives of the course are to,

- Understand the principles of theory of high voltage generation and measurements
- Understand the operation of high voltage power supplies for ac, dc, and impulse voltages
- Get familiar with various applications where high voltage field is used
- Understand breakdown of HV insulation (solid, Liquid and Gas)
- Understand lightning phenomena and HV Insulation Environmental pollution.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Explain the principles behind generating high DC-, AC- and impulse voltages	К2
C02	Develop equivalent circuit models of the different high voltage generators	КЗ
C03	Perform a dynamic response analysis of high voltage measurement system	К2
C04	Illustrate the breakdown strength of gas-filled insulation systems with simple geometries	К2
C05	Explain the principles, concepts, practices relevant to the application and hazards of electrostatic charges within the high voltage field.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М	М									L	Н	
CO2	Н	М	М	L								L	Н	L
CO3	Н	М	М	L								L	Н	L
CO4	Н	М	М									L	Н	L
CO5	Н	М	М	L		L					L	L	Н	
COURSE CONTENT:														
--	---	---	--	--	--	--	--	--						
UNIT I	OVER VOLTAGES AND INSULATION CO ORDINATIONS	9												
Introduction – Historical sketch – Comparison between AC and DC transmission – Kinds of DC links – Planning and modern trends. Causes of over voltages in transmission lines - lightning and switching over voltages - effects of over - voltages on power system equipment - protection against over voltages - surge absorbers and surge diverters – shielding - insulation coordination.														
UNIT II	GENERATION OF HIGH VOLTAGES AND HIGH CURRENT	9												
Generation of high AC voltages - cascaded transformers - generation of high DC voltages - Cockcroft Walton circuit and its qualitative analysis - generation of impulse and switching surges - Marx circuit - generation of high impulse current - Tripping and control of impulse generators														
UNIT III	MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS	9												
Measurement of AC, DC impulse and switching surges using sphere gaps, peak voltmeters, potential dividers and high speed CRO, op to Electronics method; Fiber optic method; RIV and corona measurements; partial discharge; dielectric loss measurement using bridges.														
UNIT IV	ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS	9												
lonization for break breakdow	processes - Townsend & Streamer theory - the sparking voltage - down - Breakdown in non-uniform fields and corona disch n in pure and commercial liquids and solids dielectrics	Paschen's law - Time lag arges. Conduction and												
UNIT V	HIGH VOLTAGE TESTING PRACTICES	9												
BS/IEC/VE corona an and EMC;	E specification for testing; correction factor; high voltage testir d RIV testing measurement; Non-destructive insulation tests; sou EMI/EMC testing practice; corona and ESD testing techniques.	ng of power apparatus; rces and hazards of EMI												
		TOTAL: 45 PERIODS												
TEXT BOC	KS:													
1. C.	L. Wadwa 'High Voltage Engineering' New Age International Pvt. Lt	d. Reprint 2001.												
 M.S.Naidu and N.Kamaraju, "High Voltage Engineering" Tata Mc Graw Hill Publishing Company, New Delhi, 1983 														
REFERENCE BOOKS:														
1. Su	bir Ray, 'An Introduction to High Voltage Engineering', PHI Learnin	g Private Ltd 2004.												
2. Jo El	hn Kuffel and Peter Kuffel, 'High Voltage Engineering Fundam sevier, 2010	entals', Second Edition,												

COUR	SE CODE:	COURSE TITLE:	L	Т	Р	С				
1021	2EE123	ADVANCES IN POWER SYSTEM	3	0	0	3				
COURSE CATEGORY: Programme Elective										
PREAMBLE: This course aims to model the steady-state operation of large-scale power systems and to solve the power flow problems and analyze the stability										
PREREQUISITE COURSES: Power System Analysis										
COURSE EDUCATIONAL OBJECTIVES:										
The object	tives of the co	urse are to,								
● Ui	nderstand the	harmonics and stability analysis of multi-machine sy	stem.							
• Ga	ain knowledge	on power quality standards								
● Fa	imiliar with ba	sics of grid and distribution systems and power syste	em netwo	rking.						
COURSE C	UTCOMES									
Upon	the successful	completion of the course, students will be able to:								
CO Nos.		Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)							
CO1	Explain the b	pasics of harmonics and sub harmonics oscillation		К2						
CO2	Discuss the Stability analysis of multi-machine system K2									
CO3	Describe the devices	Describe the power quality standards, curves and monitoring K2								
CO4	Outline the l	pasics of Grid and distribution systems		К2						

control

CO5

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L	L									М	Н	
CO2	Н	М	L									М	Н	L
CO3	Н	М	L					L				М	Н	L
CO4	Н	L	L									М	Н	
CO5	Н	L	L									М	Н	L

Summarize the power system networking, protection and

К2

COURSE CONTENT:								
UNIT I	HARMONICS & SUB HORMONICS OSCILLATION	9						
Understanding sub harmonics - sub harmonics in Ferro resonant circuit - sub harmonic protection - harmonic distortion & oscillation – non-linear oscillations								
UNIT II	STABILITY OF MULTIMACHINE SYSTEM	9						
Transient stabilization of multi machine power system with nontrivial transfer conductance - on-line transient stability analysis - excitation control for multi machine power system								
UNIT III	POWER QUALITY	9						
Power quality issues- standards - power quality monitoring devices - power quality conditioners for smart grid - CBEMA curves								
UNIT IV	GRID BASED POWER SYSTEM	9						
DC micro based solu	grid-based distribution power generation system – Grid – tied pov Itions applied to power distribution system.	ver system - smart grid-						
UNIT V	POWER SYSTEM NETWORKING	9						
Power sys protection	tem network reduction techniques - synchronization and kron reduction control – EMS - SCADA, RTU, PLC	tion in power networks -						
		TOTAL: 45 PERIODS						
TEXT BOO	KS:							
1. P.	Kundur, 'Power System Stability and Control', McGraw Hill Education,	2007.						
2. C.Sankaran, 'Power Quality" CRC Press, 2002.								
REFERENCE BOOKS:								
1. R.	1. R.K.Rajput, 'A Text Book of Power System Engineering', Laxmi Publication, 2011							
2. Jo	s Arillaga, 'Power System Harmonics', 2 nd Edition, Kindle Edition, Wile	y, 2007						

COU	COURSE CODE: COURSE TITLE:					L	Т	Ρ	С							
102	10212EE124 POWER PLANT ENGINEERING						3	0	0	3						
COURSE	COURSE CATEGORY: Programme Elective															
PREAM	PREAMBLE: To understand the different methods of power generation; construction and working															
principle	principle of power plants															
PREREQ																
	The objectives of the course are to,															
 Understand the performance of thermal and hydro power plants 																
•	Fxnla	in the	functio	on of n	uclear	nowe	r statio	n Sn	o pon							
•	Unde	rstand	gas, d	liesel a	nd noi	n-conv	entior	nal pov	ver pla	nts						
COURSE		COME	<u>S:</u>					•	•							
Upo	n the	succe	ssful co	omplet	tion of	the co	ourse,	studer	nts will	be able	e to:					
со					Course	- Outo					Knov	vledge	Level	(Bas	ed	
Nos.		Course Outcomes on								Taxor	revised Bloom's Taxonomy)					
CO1	E	xplain	about	therm	al pow	ver pla	nts					К	К2			
CO2	D	escrib	e the f	eature	s of hy	vdro po	ower p	lant				K	К2			
CO3	Outline the working of nuclear power plants								K	К2						
CO4	E	xplain	the wo	orking	of gas	and di	esel po	ower p	lant			K	2			
CO5	S	umma	rize th	e princ	iple of	renev	vable p	ower	plants			K	2			
CORREL	ATIO	N OF C	Os WI	TH PO	s AND	PSOs										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	P	502	
CO1	Н	L				L		М				L	Н			
CO2	Н	L				L	М	L				L	Н			
CO3	Н	L				L		М				L	Н			
CO4	Н	L				L		L				L	Н			
CO5	Н	L				М	Н	L				М	Н			
COURSE	CON	TENT:														
UNIT I THERMAL POWER PLANTS 9																
Energy thermoo Fluidized draft far Cooling	Energy resources and their availability - Types of power plants, selection of the plants - Basic thermodynamic cycles - Various component of steam power plant layout - Pulverized coal burners - Fluidized bed combustion - Coal handling systems - Ash handling systems - Forced draft and induced draft fans – Boilers Feed pumps - Super heater - Turbines - Regenerator - Condenser - Deaerators – Cooling towers															

UNIT II	HYDRO ELECTRIC POWER PLANTS	9						
Layout - Dams - Selection of water turbines - Types - Pumped storage hydel plants								
UNIT III	NUCLEAR POWER PLANTS							
Principles Reactor -	Principles of nuclear energy - Basic nuclear reactions - nuclear power station –Types of Nuclear Reactor - Nuclear Waste disposal.							
UNIT IV	GAS AND DIESEL POWER PLANTS	9						
Types - 0 improve combinat Diesel en	Types - Open and closed cycle gas turbine - Work output and thermal efficiency - Methods to improve thermal efficiency of gas turbine plant - Reheating - Intercooling - Regeneration and their combinations - Advantages and disadvantages - Comparison with steam power plants problems. Diesel engine power plant – component and layout.							
UNIT V	NON-CONVENTIONAL POWER GENERATION	9						
Solar rad geothern thermion	iation estimation, solar energy collectors, OTEC, wind power plants, tidal nal resources, fuel cell, MHD power generation -principle, thermoelectric ic power generation.	l power plants and c power generation,						
		TOTAL: 45 PERIODS						
TEXT BO	DKS:							
1. B T	ernhardt G.A.Skrotzki and William A. Vopat, 'Power Station Engineer ata Mc Graw Hill Publishing Company Ltd., New Delhi, 20 th reprint, 2002	ring and Economy',						
2. P	K Nag, 'Power Plant Engineering' Tata McGraw Hill Second Edition, 2003	1.						
REFERENCE BOOKS:								
1. 0	1. G.D. Rai, 'An Introduction to Power Plant Technology', Khanna Publishers, 1987.							
 Arora and Domkundwar, 'A Course in Power Plant Engineering', Dhanpat Rai and Co. Pvt. Ltd., 2011. 								
3. N	1.M. El-Wakil, 'Power Plant Engineering', McGraw Hill, 1985.							

COURSI	E CODE:	COURSE TITLE:	L	Т	Р	С				
10212	EE125	HIGH VOLTAGE DIRECT CURRENT TRANSMISSIO	N 3	0	0	3				
COURSE CATEGORY: Programme Elective										
PREAMBLE: This course aims to develop the skills in the area of HVDC power transmission with the analysis of HVDC converters, Reactive power control, and HVDC cables and simulation										
PREREQUIS	SITE COURSE	S: Power System Analysis and Power Electronics								
COURSE ED	UCATIONAL	OBJECTIVES:								
The objecti	ves of the co	purse are to,								
• Un pov	derstand the wer transmis	e concept, planning of DC power transmission and sion.	compari	son w	ith AC					
 Acc 	quire knowle	dge on characteristics of HVDC converters.								
• Un	derstand the	MTDC system and DC breakers with its character	istics							
• Far	niliar with re	active power and harmonics in HVDC								
• Un	derstand the	HVDC cables and Modelling of HVDC systems for	digital dy	namic	simula	ation				
COURSE OI	UTCOMES:									
Upon t	he successfu	I completion of the course, students will be able to	o:							
CO Nos.		Knowledge Leve Course Outcomes on revised Blo Taxonom								
CO1	Explain abo transmissio	out HVDC concept and planning of power n	K2							

CO2	Describe the characteristics of HVDC converters	К2
CO3	Explain the MTDC system and DC breakers with its characteristics	К2
CO4	Summarize the reactive power and harmonics in HVDC	К2
CO5	Explain the HVDC cables and Modelling of HVDC systems for digital dynamic simulation	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	М										М	Н	L
CO2	н	М										М	Н	L
CO3	н	М										М	Н	L
CO4	н	М	L									М	Н	L
CO5	Н	Н	М		Н						L	М	Н	L
	•	•	•			•	•	•		•	•	•		•

COURSE CONTENT:								
UNIT I	BASIC CONCEPTS	9						
Introducti Applicatio transmiss	Introduction of DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in DC transmission.							
UNIT II	ANALYSIS OF HVDC CONVERTERS	9						
Pulse num	ber – Choice of converter configuration – Simplified analysis of G	raetz circuit – Converter						
bridge cha	aracteristics – Characteristics of a twelve-pulse converter – Detailed	analysis of converters.						
UNIT III	MULTI TERMINAL HVDC SYSTEMS	9						
Types of MTDC system – Comparison of series and parallel MTDC system – HVDC insulation – DC line insulators – DC breakers – Characteristics and types of DC breakers								
UNIT IV	REACTIVE POWER AND HARMONICS IN HVDC	9						
Sources o Generatio	Sources of reactive power - static VAR system – Reactive power control during transients – Generation of harmonics – Types and design of various DC filters – interference telephone.							
UNIT V	HVDC CABLES AND SIMULATION OF HVDC SYSTEMS	9						
Introducti – Dielectr system sir digital dyr	on of DC cables – Basic physical phenomenon arising in DC insulati ic stress consideration – Economics of DC cables compared with A nulation – Philosophy and tools – HVDC system simulation – Mode namic simulation.	on – Practical dielectrics C cables. Introduction to ling of HVDC systems for						
		TOTAL: 45 PERIODS						
TEXT BOC	KS:							
1. Pa Ec	adiyar, K. R., 'HVDC Power Transmission System', Wiley Eastern L lition. 2015.	imited, New Delhi Third						
2. 2.	S. Rao, 'EHV-AC, HVDC Transmission and Distribution Engineering',	, Third Edition. 2013.						
REFERENCE BOOKS:								
1. Co Gi	olin Adamson and Hingorani N G, 'High Voltage Direct Curren arraway Limited, London, 1960.	t Power Transmission',						
2. A	rillaga, J., 'High Voltage Direct Current Transmission', Peter Pregrin	us, London, 1983.						
3. Ra	akosh Das Begamudre, 'Extra High Voltage AC Transmission ternational (P) Ltd., New Delhi, 1990.	Engineering', New Age						

COURSE CODE:	COURSE TITLE:	L	T	Р	С
10212EE126	LOAD FORECASTING AND GENERATION FORECASTING	3	0	0	3

COURSE CATEGORY: Programme Elective

PREAMBLE: This course aims to understand the concepts of load forecasting and generation forecasting.

PREREQUISITE COURSES: Power System Operation and Control

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand basic concepts of load forecasting and load management
- Understand the energy demand forecasting and its planning

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

COs	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Explain the load forecasting methods	К2
CO2	Summarize the Basics about energy management	К2
CO3	Illustrate the energy demand forecasting and its methodologies	К2
CO4	Explain the energy management strategy and case studies about energy forecasting	К2
CO5	Describe the planning of generation depending on forecasting	K2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н					L						М	Н	L
CO2	Н	L				L	Н					М	Н	L
CO3	Н	М										М	Н	L
CO4	Н	М	М				L				L	М	Н	L
CO5	Н	М	М			М					L	М	Н	L

COURSE CONTENT:											
UNIT I	LOAD FORECASTING	9									
Classificat methodol Weather Applicatic	ion and characterization of loads - Approaches to load for ogy - Energy forecasting - Peak demand forecasting - Nonweathe sensitive forecast - Total forecast - Annual and monthly pea ons of state estimation to load forecasting.	ecasting - Forecasting r sensitive forecast and ak demand forecasts -									
UNIT II	LOAD MANAGEMENT	9									
Introduction to Load management - Electric energy production and delivery system structure (EEPDS) - Design alternatives for EEPD systems - Communication/control techniques for load management - Tariff structure and load management - principles of macro and microeconomics and energy pricing strategies - Assessing the impacts of load management.											
UNIT III	ENERGY DEMAND FORECASTING	9									
Static an Methodo demand f	Static and dynamic analysis of energy demand - Elements of energy demand forecasting - Methodologies and models for energy demand forecasting - Techno economic approach in energy demand forecasting - Energy auditing - Energy management Power Pools and Energy Banking.										
UNIT IV	TRENDS AND CASE STUDIES	9									
Energy m decision r - Resident	nanagement strategy - Symbiotic relation between information naking - Case studies like industrial energy forecasting - Transporta tial, Commercial and agricultural energy forecasting	- Energy models and ation energy forecasting									
UNIT V	FORECASTING AND PLANNING	9									
The role of of forecas Time hori - Generat system pl	of forecasting in planning – comparison and selection of forecasting sting methods – Pattern of the Data and its effects on individual zon effects on forecasting methods - Generation planning-fundam ion planning optimized according to generating unit categories dist anning	methods. The accuracy forecasting methods - ental economic analysis ribution & transmission									
		TOTAL: 45 PERIODS									
TEXT BOC	DKS:										
1. S. N	A. Soliman, Ahmad Mohammad Al-Kandari 'Electrical Load Fore Iodel Construction' 1 st Edition, Springer, 2010.	ecasting: Modeling and									
2. A aı	llen J.Wood, Bruce F. Wollenbarg, "Power Generation, Operation ar nd Sons, 1984.	nd Control", John Wiley									
REFEREN	CE BOOKS:										
1. 1 p	1. 1 Olle I. Elgerad, "Electric Energy System Theory and Introduction", Tata Mc Graw Hill publishing company, New Delhi, 1983.										
2. l Lt	 I.J.Nagrath, D.P.Kothari, "Power System Engineering", Tata Mc Graw Hill publishing company Ltd., 1998. 										

COURSE C	CODE:	COURSE TITLE:		L	Т	Р	С							
10212EE	127	LOAD DISPATCHING		3	0	0	3							
COURSE C	ATEGOF	RY: Programme Elective												
PREAMBLE dispatch ce	E: This c entres	course aims to provide the knowledge on objectives, fu	nctio	n and	locatio	on of I	load							
PREREQUI	PREREQUISITE COURSES: Power System Operation and Control													
COURSE EI	EDUCATIONAL OBJECTIVES:													
The object	jectives of the course are to,													
• Un	derstar	nd the basics of integrated power systems												
• Ac	quire kr	nowledge on function and location of load dispatch cent	res											
• Fai	miliar w	ith equipment and general arrangement of control roor	n at l	oad di	ispatch	n centr	es							
• Ga	in know	ledge on telecommunication in power system operatio	n											
• Un	derstan	d contingencies of operating reserve and its maintenan	ce											
COURSE O	итсом	IES:												
Upon t	he succ	essful completion of the course, students will be able to):											
COs	COs Course Outcomes Knowledge Level (Based on revised Bloom's Taxonomy)													
CO1	Outlin	e the basics of integrated power systems			К2									
CO2	Explain the function and location of load dispatch centres K2													

operation

maintenance

CO3

CO4

CO5

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М										L	Н	
CO2	Н	М	L									L	Н	L
CO3	Н	М	L									L	Н	L
CO4	Н	М										L	Н	
CO5	Н	М	М									L	Н	

Illustrate the equipment and general arrangement of

Describe the telecommunication in power system

Explain the contingencies of operating reserve and its

control room at load dispatch centres

К2

К2

К2

COURSE CONTENT:											
UNIT I	INTRODUCTION	9									
Developmen Reduction i capacity - in	nt of integrated Power Systems - Benefits of operation of integrate n generating capacity due to the diversity of load demands - Re crease in the size of generating sets.	ed power systems - duction in standby									
UNIT II	OBJECTIVES, FUNCTION AND LOCATION OF LOAD DISPATCH CENTRES	9									
Objectives- Operational	Load dispatch centres and control centres - Function of the mode Planning of a power systems – Aspects of the operational planning of	rn control centre – systems									
UNIT III	FACILITIES AT LOAD DISPATCH CENTRES	9									
Equipment and General arrangement - Building, Control room - Mosaic Diagram - Mimic Board - Designing of control room and facilities of control room											
UNIT IV	TELECOMMUNICATIONS IN POWER SYSTEM OPERATION	9									
General-Tel media - PLC Communica	ecommunications in power system operation – Various power syste C, Radio Circuits, Leased Telephone Circuits, Fibre Optics and Satellit tion systems.	em -communication te Communication -									
UNIT V	DETERMINATION OF OPERATING RESERVE	9									
General of maintenanc	operating Reserve - Contingencies of operating reserve-General pra e - Problems of operating reserves.	ctice regarding the									
		TOTAL: 45 PERIODS									
TEXT BOOK	S:										
1. P.Kı	undur, 'Power System Stability and Control' McGraw Hill Education, 20)11									
REFERENCE	BOOKS:										
1. R.K.	Rajput, 'A Text Book of Power System Engineering', Laxmi Publication,	2011									
2. Mar	iani.E, Murthy.S.S, 'Advanced Load Dispatch for Power Systems', Sprir	nger, 2012									

					т	р	6			
COL	JRSE CODE:	COURSE TITLE:		L	1	Р	Ľ			
10	212EE128	REACTIVE POWER MANAGEMEN	ſ	3	0	0	3			
COURSEC	ATEGORY: Program	nme Elective					<u> </u>			
PREAMBL	E: It is aimed to pro	ovide the importance of reactive power in election	ic power netw	vork						
PREREQU	ISITE COURSES: Circ	cuit Analysis and Transmission and Distribution								
COURSE E	DUCATIONAL OBJE	CTIVES:								
The objec	tives of the course a	are to,								
Id p In D U	entifying the nece ower in electrical n nparting various typ escribing the effect nderlying the impor ustrating reactive p	ssity of reactive power compensation and d etwork bes of reactive power compensation in transmis of reactive power for HVDC systems rtance of FACTS devices ower coordination system for renewable energ	escribing the sion systems y systems	role	e of	reac	tive			
Upon	the successful com	pletion of the course, students will be able to:								
CO Nos.		Course Outcomes	Knowledge on revis Taxo	e Lev ed B onor	vel (B loon ny)	asec 1's	1			
CO1	Highlight the imp in power system	ortance of reactive power and voltage control		К2						
CO2	Explain the effect transmission syst	of reactive power on generation and ems		К2						
CO3	Explain the effect systems	of reactive power in HVDC transmission		К2						
CO4	Specify the impor	tance of FACTS devices and its applications		К2						
CO5	Indicate the effect of reactive power in grid connected renewable energy systemsK2									

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н		L	L								L	Н	L
CO2	М		L	М								L	Н	L
CO3	М		L	М	L								Н	L
CO4	L		L	L	L					L		L	Н	L
CO5	L		L	L	L					М		L	Н	L

COURSE CO	NTENT:											
UNIT I	INTRODUCTION	9										
Introduction Control thro Power Cons Improveme	n to Reactive Power – Analogy Examples – Sources and Sinks of Reactive Power ough Static and Dynamic sources of Reactive Power – Different types of Loads a sumption – Procedure for Controlling Voltage and Reactive Power - Methods for P nt.	er – Voltage and Reactive Power Factor										
UNIT II	EFFECT OF REACTIVE POWER ON GENERATION AND TRANSMISSION	9										
Generator - Reactive power capability curve - Synchronous condenser - Introduction to transmission line model – Surge impedance loading –Thermal loading of transmission lines – Methods of voltage control - Shunt reactors and reactive power control – Series and shunt capacitors – Comparison between series and shunt compensation – OLTC effect on reactive power.												
UNIT III	EFFECT OF REACTIVE POWER ON HVDC SYSTEMS	9										
Introduction neighboring	Introduction to HVDC –Effects on reactive power - Voltage source converters – Interaction between two neighboring HVDC systems – HVDC Bi-pole configuration – HVDC Back-to-Back configuration.											
UNIT IV	ROLE OF FACTS DEVICES	9										
Introduction operation - Switched Se Reactor (TS	n to FACTS – Static VAR compensators – Functions – Types – Characteristics - Converter based compensators – STATCOM – Series connected controllers eries Capacitor (TSSC) - Thyristor Controlled Series Capacitor (TCSC) – Thyristor Swi SR) – Thyristor Controlled Series Reactor (TCSR).	 Modes of Thyristor itched Series 										
UNIT V	REACTIVE POWER MANAGEMENT FOR RENEWABLE ENERGY SYSTEMS	9										
Reactive per capabilities capability of support – renewable e	ower influence on voltage and transient stability – Reactive power require for wind generators – Capability Curves – Various control objectives – Rea f solar PV generator – Control schemes in inverter circuit in solar PV system for rea Reactive power support devices – Control strategies for reactive power mar energy systems	ements and ctive power active power nagement in										
	TOTAL:	45 PERIODS										
TEXTBOOKS):											
 D.M.Taga 'Reactive 2013. 	are, 'Reactive power Management', Tata McGraw Hill, 2004. Power Management – A Resource Handbook', National Load Dispatch Centre, Nev	w Delhi, Dec,										
REFERENCE	BOOKS:											
1. J.E.Miller 2. Mohamm Review (Algorithm	, 'Reactive Power Control in Electric Power Systems', John Wiley and Sons, 1982. nad Nazmul Islam Sarkar et al., 'Reactive Power Management in Renewable Rich Po Grid Codes, Renewable Generators, Support Devices, Control Strategies and C ns', IEEE Access, 2018, DOI : 10.1109/ACCESS.2018.2838563	wer Grids: A Optimization										

COURSE CODE:	COURSE TITLE:	L	Т	Ρ	С
10212EE129	SMART GRID	3	0	0	3

COURSE CATEGORY: Programme Elective

PREAMBLE: To enable the students, acquire knowledge on smart grid, different options of architectural design and sensors, measurement technology for various aspects of smart grid, renewable energy sources and storage integration with smart grid.

PREREQUISITE COURSES: Power System Analysis

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the basic concepts, components and architecture of smart grid
- Understand the various measurement technologies in smart grid
- Educate the importance of renewable energy in smart
- Familiar about the battery technology and energy storage
- Brief about the role of Electric Vehicles in smart grid

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CON	los.				Cours	e Outc	omes				Kno O	wledge n revis Taxo	e Level ed Bloo onomy)	(Based om's		
со	1	Explain	the sm	art gric	ls com	oonent	s and a	rchitec	ture				К2			
СО	2	Describ smart g	e diffei rid	rent me	easuring	g meth	ods and	d senso	ors used	l in	К2					
со	3	Summa	rize va	rious re		К2										
СО	4	Interpret the role of batteries and energy storages												К2		
СО	5	Summa	rize the	e impor	grid		К2									
CORR	ELATI	ON OF C	Os WI	'H POs	AND P	SOs					·					
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	М	М			М	L					L		М			
CO2	М	М			М	L					L		М			
CO3	М	1 M M L									L		М			
CO4	М	M M L						L		М						
CO5	М	M M L											М			

COURSE C	ONTENT:										
UNIT I	INTRODUCTION	9									
Today's G Enhancem Function,	ird Versus Smart Grid, Rationale for Smart Grid, Computational In ent, Communication and Standards, Environment and Economic Architecture, Functions of Components	ntelligence, Power System s, Shareholders Roles and									
UNIT II	SENSORS AND MEASUREMENT	9									
Sensors fo Appliance Measuren	or Smart Grid, Monitoring and Measurement Technologies, PN s, Multi Agent Systems (MAS) Technology, Micro grid and Smart gr nent	1U, Smart meters, Smart id comparison, Wide Area									
UNIT III	DISTRIBUTED GENERATION	9									
Solar Ener Geotherm	gy, PV Systems, Wind turbine Systems, Biomass, Small and Micr al heat pumps.	o Hydro Power, Fuel Cell,									
UNIT IV	ENERGY STORAGE	9									
Batteries, energy sto	Batteries, Flow Batteries, Fuel Cell and hydrogen electrolytes, Flywheel, Super conduction magnetic energy storage systems, super capacitors, Simulation and case studies										
UNIT V	ELECTRIC VEHICLES	9									
Plugin Ele Charging,	ectric Vehicles and hybrid, Vehicle classes, Vehicle Architectur Grid Impacts, Vehicle to Grid (V2G)	e, Gird to Vehicle (G2V)									
		TOTAL: 45 PERIODS									
TEXT BOO	KS:										
1. James press,	Momoh, 'Smart Grid: Fundamentals of Design and Analysis', Jol 2012.	nn Wiley & Sons Inc, IEEE									
2. Lars.T Ltd, Re	Berger, K.Iniewski, 'Smart Grid: Applications, Communications & eprint 2015.	Security' Wiley India Pvt.									
REFERENC	E BOOKS:										
1. Fereid Acade	oon P. Sioshansi, 'Smart Grid: Integrating Renewable, Distrib mic Press, 2012.	uted & Efficient Energy',									
2. Yokoy	ama, 'Smart Grid: Technology and Applications', John Wiley & Sons	inc, 2012.									
3. Clark Press	W.Gellings, 'The Smart Grid: Enabling Energy Efficiency and Den Inc,2009.	nand Response', Fairmont									
4. Qi Hu Sons I	 Qi Huang, Shi Jing 'Innovative Testing and Measurement Solutions for Smart Grid', John Wiley & Sons Inc, 2015. 										

COURS	E CODE:						L	Т	Ρ	С			
10212	2EE130			LED LIG	GHTING		NOLOG	Y		3	0	0	3
COURSE CA	ATEGORY:	Progra	mme E	lective									
PREAMBLE to discuss used in ligh LED based developing	This cou about the nting of LE system. La LED based	rse forr signifi D based astly, th d produ	ms the cance d system ne cour ucts.	basis fo of drive ms are se also	or unde er circu discuss provid	erstand lits use sed so a es basi	ing the d in LE as to pr c hands	types D light ovide k s-on ex	and fak ing sys nowled posure	oricatic tem. T dge in (on ass	n of LE he con design a embly	Ds also itrol str and ana techniq	it aims ategies lysis of ues for
PREREQUIS	SITE COUR	SES: Po	ower El	ectroni	ics								
		AL OB.	IECTIVE	ES:									
The objectives of the course are to,													
• Sta	State the need for Illumination.												
• De	Define good Illumination.												
• Lis	List standard voltage levels.												
• Ap	Application of power electronics on LED technology.												
• De	Define the aspects of design of lighting systems.												
Maintain the lighting systems													
• Re	Rectify fault in lighting systems												
COURSE O	COURSE OUTCOMES:												
Upon t	he success	sful cor	npletio	n of the	e cours	e, stud	ents wi	ll be ab	ole to:				
CO Nos.				Course	Outco	mes				Knov or	vledge 1 revise Taxo	Level (E d Bloor nomy)	Based n's
CO1	Explain illuminat	the fu	ndame d optica	ntal el al desig	ements n	s, laws	and o	quantit	ies of		k	(2	
CO2	Explain a	bout L	ED ligh [.]	ting, ty	pes of l	ighting	S				k	(2	
CO3	Identify	the co	onstruc	tional	feature	es, par	ts and	worki	ng of		k	(2	
	illuminat	ion sys	items	a tunas	and w	orking	of now	or oloc	tronic				
CO4	circuits u	ised in	LED tee	chnolog	anu w Sy	Orking			tionic		k	(3	
	Develop	the I	Lightin	g cont	rol str	ategies	, build	ding li	ghting				
CO5	control s	ystems	s and a	pplicati	ions De	esign ar	nd fabri	icate P	CB for		k	(3	
		ing sys	teni, re	:pail, II	annen	anceor	LED Sy	stems					
CORRELATION OF COs WITH POs AND PSOs													
COs PC	D1 PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1 N	1	Н					М						
CO2	М				М								
CO3 +	I	Μ					М		М				Н
CO4				М									Μ
CO5	L		Μ							Μ			Н

COURSE CONTEN	IT:									
UNIT I	LIGHT AND ILLUMINATION	9								
Basics about Li Classification of Light - Light and Instruments used	ght: Electromagnetic Spectrum, Visible Spectrum, Wavelength, Radiometry & Photometry - Natural & Artificial Light Sources - Ch Vision - Evolution of Lighting Technologies - Merits and Demerits of d for Measurement of Light Quantities.	Characterizations, aracteristics about the technologies -								
UNIT II	LED TECHNOLOGY	9								
Physics of a LED - Electrical characteristics - Optical characteristics - Data Sheet interpretation - Types of LED's - Experimental Procedures for determination of the Characteristics - White LED Parameters - Solid State Luminaire - Solid State Luminaire Standards - Performance Measurements.										
UNIT III	POWER ELECTRONICS FOR LED LIGHTING	9								
LED Driver Requ Boost, Sepic & Fl DC Drivers, Imp Dimmable AC-DC	LED Driver Requirements and Regional Standards – Topology Overview - Linear, Buck, Boost, Buck- Boost, Sepic & Fly-back) - Driving options - Discrete based drivers, Linear drivers, Switching drivers - AC- DC Drivers, Importance of Power Factor Correction (PFC), Single Stage vs 2-Stage Design, TRIAC Dimmable AC-DC Drivers - PWM IC									
UNIT IV	LIGHT POWER & CONTROL	9								
Lighting control control algorithm Impact of lightin channel & large lighting control electrical load ma	strategies, techniques & equipment, sensors and timers, switcher n, harmonics, EI from lighting equipment – its measurement & suppring control, protocols for lighting control; Lighting control by compu- multi-channel control, stage & entertainment lighting control, archin systems; Centralized vs. distributed system; Status monitoring, conitoring, lamp life monitoring system, applications	es versus dimming ression techniques. uter, simple multi- tectural & building fault monitoring,								
UNIT V	LED MANUFACTURING TECHNOLOGY	9								
Design Fundame printing, Pick & REWORK & Repa ADVANCED: LED	ntals of LED Lamps - Testing of LED Lamps – SMD PCB Assembly te place Machines programming & practice, Reflow soldering, Han ir, Dispensing, Coating, protection Optional Packaging process- Diebonding, Wire bonding, Encapsulation etc.	chnology – Screen Id Soldering, SMD								
	т	OTAL: 45 PERIODS								
TEXT BOOKS:										
1. Amar K Publishir	Ganguly, 'Optoelectronic Devices and Circuits-Theory and App g House, 2010.	olications', Narosa								
2. P.S.Bimb	hra, 'Power Electronics', Khanna Publishers, 2015.									
REFERENCE BOO	KS:									
 E. Fred S Anil Valia 	chubert, 'Light-Emitting Diodes' Cambridge University Press, 2014. a, 'Light Design', Mili Jain Publishers, 2012.									

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10212EE131	FLEXIBLE AC TRANSMISSION SYSTEMS	3	0	0	3

COURSE CATEGORY: Programme Elective

PREAMBLE: This course will describe about basic concepts, different types, scope and applications of FACTS controllers in power transmission system

PREREQUISITE COURSES: Power Electronics

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Know the importance of compensation in transmission lines and the concepts of FACTS devices.
- Illustrate the design, modelling and applications of SVC.
- Familiar with the operation, modes, modelling and applications of TCSC.
- Study the principle, characteristics, modelling and applications of STATCOM and SSSC.
- Summarize about the importance in coordination of FACTS controllers.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basic fundamental of FACTS controllers	К2
CO2	Summarize about Static VAR Compensators	К2
CO3	Explain about Modelling, Operation and control strategies of Static series compensation-SVC	К2
CO4	Explain the voltage source-based FACTS controllers	К2
CO5	Explain the modelling and design of Coordinating multiple FACTS controllers using control techniques	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L									L	М	Н	L
CO2	Н	L	L								L	М	Н	L
CO3	Н	L	L								L	М	Н	L
CO4	Н	L	L								L	М	Н	L
CO5	Н	L	L								L	М	Н	L

COURSE CONTENT:									
UNIT I	INTRODUCTION TO FACTS	9							
Reactive Power Fl possible	power control in electrical power transmission lines –Uncompensated transmissi ow in AC System – relative - importance of controllable parameter –opportunities for benefits for FACTS.	on line - r FACTS –							
UNIT II	STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS	9							
Need for compens and cont	compensation – introduction to shunt & series compensation – objectives of shunt ation – configuration & operating characteristics, Static shunt compensators: SVC - C rol.	: & series Operation							
UNIT III	SERIES COMPENSATION AND APPLICATIONS	9							
Static series compensation: TSSC - Modeling, Operation and control, Different modes – Variable reactance model –Applications: Improvement of the system stability limit –Enhancement of system damping.									
UNIT IV	VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS	9							
Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltag instability - SSSC-operation of SSSC and the control of power flow –Modeling of SSSC in load flow an transient stability studies.									
UNIT V	CO-ORDINATION OF FACTS CONTROLLERS								
Introduct operating controlle	tion to Unified Power Flow Controller (UPFC) & Interline Power Flow Controller (IPFC g principles UPFC – introduction to sub synchronous Resonance - Coordination of resusing linear control techniques. Introduction to SCADA and security monitoring	C) – basic multiple							
	is using inear control teeningues. Introduction to SeADA and Security monitoring.								
	TOTAL: 45	PERIODS							
TEXT BO	TOTAL: 45	PERIODS							
TEXT BO	TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001.	PERIODS							
TEXT BO 1. N F 2. F T	TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001. A. Mohan Mathur and Rajiv K. Varma, 'Thyristor Based FACTS Controller for Transmission Systems', Wiley Inter science Publications, 2002	PERIODS nology of Electrical							
TEXT BO	TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001. A. Mohan Mathur and Rajiv K. Varma, 'Thyristor Based FACTS Controller for Gransmission Systems', Wiley Inter science Publications, 2002 CE BOOKS:	PERIODS nology of Electrical							
TEXT BO 1. N F 2. F 7 REFEREN 1. F (TOTAL: 45 Total:	PERIODS nology of Electrical							
TEXT BO 1. N F 2. F 7 REFEREN 1. F (2. N	TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001. A. Mohan Mathur and Rajiv K. Varma, 'Thyristor Based FACTS Controller for Gransmission Systems', Wiley Inter science Publications, 2002 CE BOOKS: Padiyar K.R., 'FACTS Controllers in Power Transmission and Distribution', New Age Inter P) Limited Publishers, 2008. Jarain G. Hingorani, 'Flexible AC Transmission', IEEE Spectrum, April 1993, 40-45	PERIODS nology of Electrical							
TEXT BO	TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001. A. Mohan Mathur and Rajiv K. Varma, 'Thyristor Based FACTS Controller for Transmission Systems', Wiley Inter science Publications, 2002 CE BOOKS: Padiyar K.R., 'FACTS Controllers in Power Transmission and Distribution', New Age Inter P) Limited Publishers, 2008. Jarain G. Hingorani, 'Flexible AC Transmission', IEEE Spectrum, April 1993, 40-45 Jarain G. Hingorani, 'High Power Electronics in Flexible AC Transmission', IEE Ingineering Review, 1998.	PERIODS nology of Electrical ernational E Power							
TEXT BO 1. N F 2. F 7 REFEREN 1. F (2. N 3. N E 4. N	TOTAL: 45 TOTAL: 45 DKS: Jarain G. Hingorani and Laszlo Gyugyi, 'Understanding FACTS – Concepts and Tech lexible AC Transmission Systems', Standard Publishers, New Delhi, 2001. A. Mohan Mathur and Rajiv K. Varma, 'Thyristor Based FACTS Controller for transmission Systems', Wiley Inter science Publications, 2002 CE BOOKS: Padiyar K.R., 'FACTS Controllers in Power Transmission and Distribution', New Age Inter P) Limited Publishers, 2008. Jarain G. Hingorani, 'Flexible AC Transmission', IEEE Spectrum, April 1993, 40-45 Jarain G. Hingorani, 'High Power Electronics in Flexible AC Transmission', IEE ingineering Review, 1998. Ailler. T.J.E., 'Reactive Power Control in Electric System', John Wiley & Sons, 1997.	PERIODS nology of Electrical rnational E Power							
TEXT BO 1. N F 2. F 7 REFEREN 1. F (2. N 3. N E 4. N 5. C	TOTAL: 45 Total:	PERIODS nology of Electrical ernational E Power							
TEXT BO 1. N F F 2. F T REFEREN 1. F (0 2. 3. N 4. N 5. E 6. S E E	TOTAL: 45 TOTAL:	PERIODS nology of Electrical ernational E Power Electrical							

COURSE CODE:	L	Т	Р	С							
10212EE132	3	0	0	3							
COURSE CATEGORY: Programme Elective											
PREAMBLE: In this course student will get exposure to basic principle of operation, structure,											
characteristics of power	converters.										
PREREQUISITE COURSES	: Power Electronics										
COURSE EDUCATIONAL	OBJECTIVES:										
The objectives of the co	urse are to,										

- Explain about the Single-phase bridge rectifiers with RL, RLE loads & effect of source impedance
- Explain about the three phase bridge rectifiers with RL, RLE loads & effect of source impedance
- Teach about design and analysis of dc –dc converters
- Present on single-phase bi-directional controllers with R, L and R-L loads, 3-phase controllers.
- Explicate the single phase and three phase cycloconverters.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the types loads with single phase thyristor-controlled converter.	К2
CO2	Describe the operation, characteristics and performance parameters three phase thyristor-controlled converter.	К2
CO3	Identify the types of dc-dc converters.	К2
CO4	Explain the single-phase bi-directional controllers with R, L and R-L loads & 3-phase controllers.	К2
CO5	Describe the principle of operation of single phase and three phase Cycloconverters.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L										L	Н	L
CO2	Н	М	L										Н	L
CO3	Н	М	L										н	
CO4	Н	М	L									L	н	L
CO5	Н	L											Н	

COURSE C	ONTENT:	
UNIT I	SINGLE PHASE AC TO DC CONVERTERS	9
Single pha freewheel harmonics overlap, re	ase bridge rectifiers, half controlled and fully controlled conver- ing diodes, Dual Converter, sequence control of converters-ir and output ripple, smoothing inductance-power factor, effect o eactive power and power balance in converter circuits.	ters with RL, RLE loads, nverter operation, Input f source impedance and
UNIT II	THREE PHASE AC TO DC CONVERTERS	9
Semi and sequence inductance	fully controlled converters with R, RL, RLE loads, freewheeling control of converters-inverter operation, Input harmonics and ce-power factor, effect of source impedance and overlap, 12 pulse con	diodes, Dual Converter, output ripple, smoothing verter.
UNIT III	DC TO DC CONVERTERS	9
Principle o classificati multiphase	of operation, choice of communication circuit elements, step dow on, Voltage and current commutated choppers, effect of source I e chopper, resonant converters.	n and step-up choppers, nductance, Filter circuits,
UNIT IV	AC VOLTAGE CONTROLLERS	9
Principle of controllers	of phase control, single-phase bi-directional controllers with R, L s, different configurations, Analysis with pure R and L loads.	and R-L loads, 3-phase
UNIT V	CYCLOCONVERTERS	9
Principle of harmonics	of operation, single phase and three phase cyclo converters, Powe and analysis of power factor	er circuits, gating signals-
		TOTAL: 45 PERIODS
TEXT BOO	KS:	
1. Ra Ed	shid M.H., 'Power Electronics Circuits, Devices and Applications', Pition, New Delhi, 1995.	rentice Hall India, Second
2. P.	C Sen.,'Modern Power Electronics ', Wheeler publishing Co, First Editi	on, New Delhi-1998.
REFERENC	E BOOKS:	
1. M W	ohan N., Undeland and Robbins, 'Power Electronics Converters - Appl iley and sons, Inc., New York, 1995.	lications and Design', John

COURSE	CODE:	COURSE TITLE:		L	Т	Ρ	С				
10212E	E133	AUTOMOTIVE ELECTRICAL & ELECTRONIC SYSTE	& ELECTRONIC SYSTEMS 3 0 0								
COURSE C	ATEGOR	Y: Programme Elective									
PREAMBL	E: The co	ourse is aimed at imparting fundamental knowledge ab	out the el	ectri	cal la	yout	and				
to unders	to understand the various sensors and related control system assembly within an automobile.										
PREREQU	PREREQUISITE COURSES: Electronic Circuits										
COURSE E	DUCATIO	DNAL OBJECTIVES:									
The objec	tives of tl	he course are to,									
• E>	kplain the	basic layout of an automotive electrical system									
•	ustrate tl	he Starting and Charging systems of a vehicle.									
• D	escribe al	bout the Sensors and Actuators used in an Automobile.									
• E>	kplain the	control systems used within a vehicle.									
•	ustrate a	bout the basic management system within a vehicle.									
COURSE C	OUTCOM	ES:									
Upon	the succe	essful completion of the course, students will be able to	:								
CO Nos.	dge L vised axon	evel Bloc omy)	(Base om's	d							
C01	Emphas systems	ize the basic architecture of Automotive Electrical		K2	2						

	systems.	
C02	Illustrate the problems behind the drives employed in a vehicle.	К2
C03	Relate the sensor arrangements in a vehicle	К2
C04	Explain the control strategies on a vehicle	К2
C05	Outline the parameters to be controlled for the Engine management system.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М	L									L	Н	L
CO2	Н	М	L									L	Н	L
CO3	н	М	L	L								L	н	L
CO4	н	М	L	L								L	н	L
CO5	Н	М	L	L								L	Н	L
CO5	Н	М	L	L								L	Н	

COURSE	CONTENT:							
UNIT I	INTRODUCTION TO AUTOMOTIVE ELECTRICAL SYSTEM	9						
Automot diagrams Diagnosis	Automotive Electrical Layout, Automotive component operation, Electrical wiring terminals, Circuit diagrams and symbols On Board Diagnostics, Dash Board instruments, Warning Systems, Fault Diagnosis and troubleshooting.							
UNIT II	STARTING & CHARGING SYSTEMS	9						
Condition and cons of Drives	Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motors& driving mechanism, D.C. Generator and Alternator-Maintenance of Drives- Regulation for Charging, lighting lamps and Fuses.							
UNIT III	AUTOMOTIVE SENSORS	9						
Introduct Sensor, I humidity	ion, Basic Sensor Arrangement, Types of sensors, Oxygen Sensor, Crankin Engine cooling water Sensor, engine oil pressure sensor, Flow sensor, sensor, Speed and Acceleration sensor, Knock sensor, Torque sensor, Yaw r	g Sensor, Position Temperature and ate sensors						
UNIT IV	AUTOMOTIVE CONTROL SYSTEMS	9						
Automot System, E System, S	ve microcontrollers, Engine Control Systems, Transmission Control Syste Braking Control System, Traction Control System, Stability Control System, S Iteering Control System	em, Cruise Control Suspension Control						
UNIT V	ENGINE MANAGEMENT SYSTEM	9						
Engine-Co Control, e emission	onstruction & stroke Classification-Sensor arrangements in Engine, Open & engine cooling and warm up control, acceleration, detonation and idle speed control engineering	Closed loop d control, exhaust						
	т	OTAL: 45 PERIODS						
TEXT BO	DKS:							
1. V 2	Villiam B. Ribbens, Norman P. Mansour 'Understanding Automotive Ele 012	ctronics', Elsevier,						
2. P	L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education, 200	4.						
REFEREN	CE BOOKS:							
1. T	om Denton 'Automobile Electrical and Electronics Systems', Elsevier, 4 th Edi	tion, 2012.						
2. R	obert Bosch 'Automotive Handbook' SAE, 1 st Edition, 2011.							
3. C	r.Kirpal Singh, 'Automobile Engineering', Standard Publishers, Vol- 1 and Vo	ol- 2, 2012.						
4. R	.K. Jurgen, 'Automotive Electronics Handbook', McGraw Hill, 2 nd Edition 201	10.						

COURSE CODE:	
10212FF134	

COURSE TITLE: FUNDAMENTALS OF ELECTRIC & HYBRID VEHICLES

L	Т	Р	С
3	0	0	3

COURSE CATEGORY: Programme Elective

PREAMBLE: This course aims in providing the fundamental knowledge on electric and hybrid power trains, principle of regenerative braking and environmental advantages of electric & hybrid vehicles.

PREREQUISITE COURSES: Power Electronics, Basic Electronics and Measurement Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Impart the knowledge on vehicle propulsion principle
- Understand the electric vehicles and its powertrains
- Get fundamental knowledge on hybrid electric vehicles
- Understand regenerative braking in electric vehicles
- Know the advantages of electric vehicles in various environment

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Enumerate the principle of vehicle propulsion and braking.	К2
C02	Outline the principle & performance of an electric vehicle.	К2
C03	Illustrate the working principle of a Hybrid Electric Vehicle.	К2
C04	Explain the braking system of EV, HEV and FCV.	К2
C05	Articulate the effects of electric and hybrid vehicles on environment	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	М	L			L					М	М	Н	М
CO2	Н	М	L			L					М	М	Н	М
CO3	Н	М	L			L					М	М	Н	М
CO4	Н	М	L			L					М	М	Н	М
CO5	Н	М	L			L	М				М	М	Н	М

COURS	COURSE CONTENT:									
UNIT	FUNDAMENTALS OF VEHICLE PROPULSION	9								
Genera Tractive Perforn	General Description of Vehicle Movement - Vehicle Resistance - Dynamic Equation - Power Train Tractive Effort and Vehicle Speed - Vehicle Power Plant and Transmission Characteristics - Vehicle Performance - Operating Fuel Economy - Brake Performance									
UNIT I	ELECTRIC VEHICLE& PROPULSION SYSTEMS	9								
Configu Transm Consun Permar	Configurations of EVs - Performance of EVs - Traction Motor Characteristics - Tractive Effort and Transmission Requirement - Vehicle Performance - Tractive Effort in Normal Driving- Energy Consumption - Principle of Operation and Performance - DC Motor Drives - Induction Motor Drives - Permanent Magnet BLDC Motor Drives - SRM Drives									
UNIT I	I HYBRID ELECTRIC VEHICLES	9								
HEV-Ty Combir	pes of HEVs-Series & Parallel HEVs-Advantages & Disadvantag ation - Design of an HEV - Hybrid Drive trains - sizing of components -	jes – Series - Parallel rated vehicle velocity								
UNITI	/ REGENERATIVE BRAKING	9								
Braking versus Decelei Parallel	Braking Energy Consumed in Urban Driving - Braking Energy versus Vehicle Speed - Braking Energy versus Braking Power - Braking Energy versus Braking Power - Braking Energy versus Vehicle Deceleration Rate - Braking Energy on Front and Rear Axles - Brake System of EV, HEV, and FCV - Parallel Hybrid Braking System - Fully Controllable Hybrid Brake System									
UNIT V	ELECTRIC VEHICLES & ENVIRONMENT	9								
Vehicle Contex Fueled vehicle	Pollution: the Effects - Vehicles Pollution: a Quantitative Analysi - Alternative and Sustainable Energy Used via the Grid - Using S Vehicles - The Role of Regulations and Law Makers - Case study 5.	s - Vehicle Pollution in Sustainable Energy with of rechargeable battery								
		TOTAL: 45 PERIODS								
TEXT B	DOKS:									
1.	Husain I. 'Electric and Hybrid Vehicles: Design Fundamentals' CRC Pre	ess, 2011.								
2.	Larminie, James, and John Lowry 'Electric Vehicle Technology' John V	Viley & Sons, Ltd. 2003								
REFERE	NCE BOOKS:									
1. 2.	 Emadi, Ali, 'Handbook of Automotive Power Electronics and Motor Drives' CRC Press, 2005. Ehsani, Mehrdad, Yimin Gao, and Ali Emadi 'Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design' CRC press, 2009. 									
3.	Soylu, Seref, 'Electric Vehicles: The Benefits and Barriers' InTech, 201	.1.								
4.	Soylu, Seref. 'Electric Vehicles–Modelling and Simulations' InTech 2011.	Europe, Rijeka, Croatia,								

CC	OURSE	JRSE CODE: COURSE TITLE: L											Ρ	С
1	.0212E	0212EE135 SPECIAL ELECTRICAL MACHINES 3										0	0	3
COURS	E CATI	CATEGORY: Programme Elective												
PREAN	1BLE:	This co	ourse e	expose	s the	studen	ts to	the co	nstruct	ion, p	rincipl	e of o	operatio	on and
perform	performance of special electrical machines as an extension to the study of AC & DC electrical													
machir	achines.													
PRERE	EQUISITE COURSES: DC Machines and Transformers, AC Machines													
COURS	E EDU	CATIO	NAL OI	BJECTI	VES:									
The objectives of the course are to,														
•	Famil	iar wit	h the	constr	uction	, princ	iple of	opera	ition a	nd per	forma	nce o	f synch	ronous
	brush	tance iless D.	motor: .C. mot	s, step tors.ar	ping r nd pern	notors _. nanent	, swite magn	ched in et svho	eluctan hronou	ice mo us mot	otors, ors.	perma	anent r	nagnet
COURS		COME	S:	,-	- 1		-0							
Up	on the	succes	ssful co	ompleti	ion of t	he cou	ırse, st	udents	will be	able t	o:			
				-										
											L	evel o	f learni (Bacad	ng
Nos.				C	ourse	Outcor	nes				r	evised	l Bloom	n's
												taxo	nomy)	
CO1	Expla	ain tł	ne Co	onstruc	tion,	princi	ple o	f op	eration	and			к2	
	perfo	ormano	ce of sy	ynchroi	nous re	eluctan	ice mot	tors.						
CO2	Outli	ine the	contro	ol sche	me for	steppe	er moto	ors			К2			
CO3	Sum	marize	the pe	erforma	ance ch	naracte	ristics	and co	ntrol o	f			К2	
	Switt													
CO4	brus	hless D	ne op).C. mo	otors.	n and	contr	οι οτρ	bermar	ient n	iagnet			К2	
	Inter	pret	oper	rating	cha	racteri	stics	of	perm	anent				
CO5	mag	net syn	chron	ous mo	otors.			•	peri				К2	
CORRE		N OF C	Os WI	TH POs		2505					•			
							1				[1		
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н		L								L	L	М	L
CO2	Н	H L I I I I I								L	L	М	L	
CO3	Н	H L										L	М	L
CO4	Н		L								L	м	М	L
CO5	Н		L								L	L	М	L

	NT:	
UNIT I	SYNCHRONOUS RELUCTANCE MOTORS	9
Constructional f Reluctance and Characteristics.	eatures – Types – Axial and Radial flux motors – Operating Hybrid Motors – SYNREL Motors – Voltage and Torque Equatio	principles – Variable ns - Phasor diagram
UNIT II	STEPPER MOTOR	9
Constructional Single and multi Drive circuits – I	Features – Principle of operation – Variable reluctance moto -stack configurations – Torque equations – Modes of excitation Microprocessor control of stepper motors – Closed loop contro	or – Hybrid motor - ns – Characteristics - I.
UNIT III	SWITCHED RELUCTANCE MOTORS	9
Constructional f Steady state per Methods of Ro Characteristics.	eatures – Rotary and Linear SRMs - Principle of operation – rformance prediction- Analytical method -Power Converters an tor position sensing – Sensor less operation – Closed loo	Torque production - nd their controllers - p control of SRM ·
UNIT IV	PERMANENT MAGNET BRUSHLESS D.C. MOTORS	9
Permanent Mag operation – Typ controllers – Mo	gnet materials – Magnetic Characteristics – Permeance coe es – Magnetic circuit analysis – EMF and torque equations –Co otor characteristics and control.	fficient -Principle of ommutation – Power
UNIT V	PERMANENT MAGNET SYNCHRONOUS MOTORS	9
Principle of ope	eration – Ideal PMSM – EMF and Torque equations – Armat	ure reaction MMF -
Torque/speed c	haracteristics - Power controllers - Converter Volt-ampere requ	Phasor diagram - iirements.
Torque/speed c	haracteristics - Power controllers - Converter Volt-ampere requ	Phasor diagram - irements. TOTAL: 45 PERIODS
Torque/speed c	haracteristics - Power controllers - Converter Volt-ampere requ	Phasor diagram - irements. TOTAL: 45 PERIODS
Text BOOKS: 1. T.J.E. M Oxford,	haracteristics - Power controllers - Converter Volt-ampere requ iller, 'Brushless Permanent Magnet and Reluctance Motor Driv 1989.	Phasor diagram - irements. TOTAL: 45 PERIODS es', Clarendon Press
Text BOOKS: 1. T.J.E. M Oxford, 2. 2. T. Ker 1984.	iller, 'Brushless Permanent Magnet and Reluctance Motor Driv 1989.	Phasor diagram - irements. TOTAL: 45 PERIODS es', Clarendon Press endon Press London
Text BOOKS: 1. T.J.E. M Oxford, 2. 2. T. Ker 1984. REFERENCE BOO	iller, 'Brushless Permanent Magnet and Reluctance Motor Driv 1989. njo, 'Stepping Motors and their Microprocessor Controls', Clar	Phasor diagram - irements. TOTAL: 45 PERIODS es', Clarendon Press endon Press London

	COURSE TITLE:	L	Т	Р	С					
10212FF136	ELECTROMAGNETIC INTERFERENCE AND	2	0	0	2					
1021222100	COMPATIBILITY	5	U	3						
COURSE CATEGORY: Programme Elective										
PREAMBLE: To n	nake the student understand electromagnetic interfere	nce an	d compa	atibility						
PREREQUISITE C	OURSES: Electromagnetic Theory									
COURSE EDUCAT	TIONAL OBJECTIVES:									
The objectives of	f the course are to,									
Understa	and the EMC regulation and methods of eliminating int	erferer	nces							
• Familiar	with the Methods of grounding of cable shield									
Understa	and the concept of filtering and shielding									
 Impart k 	Impart knowledge on types of digital circuit noises									
Understa	Understand the electrostatic discharge and standards.									

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the EMC regulation and methods of eliminating interferences	К2
CO2	Explain the Methods of grounding of cable shield	К2
CO3	Describe the concept of filtering and shielding	К2
CO4	Outline the types of digital circuit noises	К2
CO5	Illustrate about the electrostatic discharge and standards.	К2

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	L		L								L	М	
CO2	Н										L		М	
CO3	н	Н									L		М	
CO4	н		М									L	М	
CO5	н	Н		Н								L	М	
r	•										•	•	•	•

COURSE CONTENT:								
UNIT I	INTRODUCTION	9						
Sources of EMI, Conducted and radiated interference - Characteristics - Designing for electromagnetic compatibility (EMC) - EMC regulation- typical noise path - use of network theory - methods of eliminating interferences.								
UNIT II	METHOD OF HARDENING	9						
Cabling – capacitive coupling - inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds -single point and multipoint ground systems - hybrid grounds- functional ground layout – grounding of cable shields - ground loops - guard shields.								
UNIT III	BALANCING, FILTERING AND SHIELDING	9						
Power supply decoup – near and far field magnetic material - c	Power supply decoupling - decoupling filters - amplifier filtering – high frequency filtering shielding – near and far fields - shielding effectiveness - absorption and reflection loss, Shielding with magnetic material - conductive gaskets, windows and coatings - grounding of shields.							
UNIT IV	DIGITAL CIRCUIT NOISE AND LAYOUT	9						
Frequency versus tin sources- digital circui voltages - unused inp	ne domain - analog versus digital circuits - digital logic t ground noise – power distribution-noise voltage object uts - logic families.	noise - internal noise ives - measuring noise						
	ELECTROSTATIC DISCHARGE, STANDARDS AND LABORATORY TECHNIQUES	9						
Static Generation - hi versus EMC, Industria Laboratory technique	uman body model - static discharges-ED protection in ec al and Government standards – FCC requirements – CISF es - Measurement methods for field strength - EMI.	quipment design - ESD PR recommendations -						
		TOTAL: 45 PERIODS						
TEXT BOOKS:								
1. Henry W.Ott,	'Noise Reduction Techniques in Electronic Systems', Joh	n Wiley & Sons, 1989.						
 Bernhard Keiser, 'Principles of Electro-magnetic Compatibility', Artech House, Inc. (685 Canton Street, Norwood, MA 020062 USA) 1987. 								
REFERENCE BOOKS:								
1. Bridges, J.E N Wiley and So	Ailleta J. and Ricketts.L.W., 'EMP Radiation and Protect ns, USA 1976.	ive Techniques', John						

COL	JRSE C	CODE:				CC	DURSE	TITLE:			ι	_ T	Р	С
10	212EE	137				SOLI	O STAT	'E DRI\	/ES		Э	3 0	0	3
COURSE	E CATI	EGORY:	Prog	ramme	Electi	ve								
PREAM	BLE: T	his cou nic cor	ırse pr nverter	ovides	an int	troduct vides t	tion to the de	the o	peration	on of ele s of cont	ectric dı rollers.	rives co	ntrolled	from a
	IISITE	COURS	SES: El	ectrica	I Mach	ines P	ower	Flectro	nics					
COURSE					/FS·									
The obj	ective	s of the	cours	e are t										
,	Undo	rctand	the sta	blo ct		tata an	oratia	n and i	trancia	nt duna	mics of	a mata		ist a ma
•	Study	rstand	nalvze	the o	peratio	on of t	the co	n and i nverte	r/chor	per fed	dc driv	e and t	to solve	stem. simple
	probl	ems.	- , -						, 1-					
•	Study	and ur	ndersta	and the	e opera	ation o	f both	classic	al and	modern	inducti	ion mot	or drive	s.
•	Unde to lea	rstand	the di basics	fference of peri	ces bet manen	ween t magr	synchr net syn	ronous	moto	r drive a ntor driv	Ind indu es	uction n	notor dr	ive and
•	Analy	ze and	desig	n the o	current	t and s	speed	contro	ollers fo	or a clos	sed loop	o solid-s	state DO	c motor
	drive.													
COURSE	OUT	COMES	:											
Upc	on the	succes	stul co	mpleti	on of t	he cou	irse, st	udent	s will b	e able to	D:			
со					Cour		comos				Kno	owledge	e Level (Based
Nos.					Cours	se Out	comes					Тахо	onomy)	111 5
CO1	E	xplain	the co	ncept o	of AC A	ND DC	drive	systen	า				К2	
CO2	ll d	llustrate Irive an	e the o d to so	peration	on of t nple pi	he con roblem	verter s	/ chop	oper fe	d dc			К2	
CO3	E	xplain	the op	eratior	n of bo	th clas	sical a	nd mo	dern ir	duction			К2	
CO4	n	notor d	rives	norati	on of c	wachre		motor	drives				к2	
	F	xnlain	the on	eration	n of sn	ecial m	achine	drive	s and i	ts				
CO5	a	pplicat	ions.	cration	10130				Junu				К2	
CORREL	ATIO	N OF CO	Os WIT	'H POs	AND F	SOs								
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	L								L	L	Н	L
CO2	Н	Н	Μ								L	L	Н	L
CO3	Н	Н	Μ								L	L	Н	L
CO4	H	H	H								L	L	H 	L
CO5	Н	H	Μ								L	L	Н	L

COURSE C	ONTENT:	
UNIT I	FUNDAMENTALS OF ELECTRIC DRIVES	9
Advantage Torque-sp motor for electric dr drives.	e of electric drives – Parts and choice of electrical drives – Status eed characteristics of motor and load – Selection of motor power ra heating and cooling – Classes of duty cycle – Determination of m ives – Modes of operation – Speed control and drive classifications	s of DC and AC drives – ating – Thermal model of notor rating – Control of – Closed loop control of
UNIT II	CONVERTER / CHOPPER FED DC MOTOR DRIVE	9
Steady sta separately operation- loop dc dr	ate and transient analysis of the single and three phase fully or excited D.C motor drive – Continuous and discontinuous conductio – Converter control – Chopper-fed D.C drive – Steady-state analysis - ive.	controlled converter fed n mode – Multiquadrant - Block diagram of closed
UNIT III	INDUCTION MOTOR DRIVES	9
Analysis an single-pha voltage co resistance control – V	nd performance of three-phase induction motor – Operation with un sing and unbalanced rotor impedance – Starting – Braking – Tra ontrol –Adjustable frequency control of VSI and CSI fed inductio control – Slip-power recovery drives – Open loop Volts/Hz cont /ector control of induction motor – Block diagram of closed loop driv	balanced source voltage, ansient analysis – Stator on motor – Static rotor rol – Principle of vector e.
UNIT IV	SYNCHRONOUS MOTOR DRIVES	9
Open loop synchrono power fa Synchrono	Volts/Hz control and self-control of CSI and VSI fed synchronous mo ous motor – Microprocessor based synchronous motor control – Ma ctor control – Permanent magnet (PM) synchronous motor – ous Motor (PMSM).	otor – Cycloconverter fed arginal angle control and vector control of PM
UNIT V	BLDC, STEPPER AND SWITCHED RELUCTANCE MOTOR DRIVES	9
Brushless motor Dri industrial	DC motor drives and its applications – Variable reluctance and per ves – Operation and control of switched reluctance motor – Applic drive.	manent magnet stepper ations, modern trends in
		TOTAL: 45 PERIODS
TEXT BOO	KS:	
1. Bi	mal K. Bose, 'Modern Power Electronics and AC Drives', Pearson Edu	cation, 2002.
2. Du	ubey, G.K., 'Fundamentals of Electrical Drives', 2nd Edition, Narosa Pu	ublishing House, 2001.
REFERENC	E BOOKS:	
1. Pi	llai, S.K., 'A First Course on Electrical Drives', Wiley Eastern Limited, 1	993.
2. Kr 20	ishnan, R., 'Electric Motor and Drives Modelling, Analysis and Contro 101.	ol', Prentice Hall of India,
3. Ve	edam Subrahmanyam, 'Electrical Drives', Tata McGraw-Hill Publis 194.	shing Company Limited,
4. Go	opal K.Dubey, 'Power semiconductor Controlled Drives', Prentice Hall	,1989

											1	Т	Р	C
10	URSE C 1212FF	ODE: 138			DRI		RSE TIT	LE: OBOTI	rs					
		100			FN		.5 OF N	OBOIN	C3		3	0	0	3
COURS	E CATE	GORY:	Progra	mme E	lective									
PREAM	IBLE: T	his co	urse w	ill imp	art the	basic	conce	pts of	roboti	cs and	their o	design	manuf	acture,
applica	tion, ai	nd stru	ctural c	lisposit	ion									
PREREC	QUISIT		SES: №	licropro	ocessor	& Mic	rocontr	ollers						
COURS	E EDUG		IAL OB.	IECTIVE	S:									
The obj	jectives	s of the	course	e are to	,									
•	Under	stand t	the bas	ic com	oonent	s of rot	oots an	d its se	nsors.					
٠	Know	the ba	sics of (Control	and ar	alysis (of robo	tics mo	tion.					
٠	Give a	ı brief i	ntrodu	ction al	oout ar	tificial i	intellige	ence.						
٠	Write	basic p	orogran	nming i	n robot	tics.								
٠	Famili	ar with	the ap	plicatio	ons of r	obots.								
COURS	E OUT	COMES	:											
Up	on the	succes	sful cor	npletio	n of th	e cours	e, stud	ents wi	ill be al	ole to:				
со					_	_					Know	ledge	Level (I	Based
Nos	5.				Course	Outco	mes				on	revise Taxoi	d Bloor nomy)	n's
CO1	L D	escribe	the ba	isic con	nponer	its of ro	obots a	nd its s	ensors			k	2	
CO2	<u>2</u> E	xplain t	he bas	ics of C	ontrol	and and	alysis o	f robot	ics mot	tion		k	2	
	3 11	lustrate	e the ba	asics of	artifici	al intel	ligence					ĸ	2	
							0							
CO4	1 V	/rite ba	isic pro	gramm	ing in r	obotics	S					k	3	
COS	5 0	utline	the app	licatio	ns of ro	bots						k	2	
CORRE	LATION	OF CC	Ds WITI	H POs A	ND PS	Os								
Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

		_		_	 	-	 		_		
CO1	Н		L						L	Н	
CO2	Н	М	L						М	н	
CO3	Н		L						М	Н	L
CO4	Н	М	L						М	н	М
CO5	Н		L							Н	

COURSE	CONTENT:	
UNIT I	INTRODUCTION	9
Automati source, ir BASIC CO	on and robotics - Robot Anatomy - Classifications of Robots by DOF m Itelligence and application area. MPONENS OF ROBOTS	notion, platform, power
a) Manip	ulators – Wrists - End effectors - Control units - Power units - Robot sen	sors:
b) Robot mobile Ro	sensors - Proximity sensors - Ranger sensors - Tactile sensors - Visu bbots.	al sensors- Sensors for
UNIT II	ROBOT MOTION ANALYSIS AND CONTROL	9
Introduct Manipula	ion to manipulator kinematics - Homogeneous transformations ar tor path control - Robot dynamics - configuration of a robot controller	nd Robot kinematics - Obstacle avoidance.
UNIT III	ARTIFICIAL INTELLIGENCE	9
AI –techn Sensing a system - natural n	iques – fuzzy logic, neural network - LISP programming - AI and Roboti and digitizing function machine vision - Image processing and analy natural language processing - speech recognition - legged locomotior etworks computing.	cs - LIPS in the factory - vsis training and vision n - collision avoidance -
UNIT IV	ROBOT PROGRAMMING	9
Methods space - limitatior	of Robot programming - lead through programming methods - a robo motion interpolation - weight, signal and delay commands - Bran s of lead through methods.	ot program as a path in ching, capabilities and
UNIT V	APPLICAIONS OF ROBOT	9
Material	handling - Processing operations - Assembly and inspection - Future app	olication.
		TOTAL: 45 PERIODS
TEXT BOO	DKS:	
1. N T	ikell P.Groover, Michell wein,Roger N. Nagal and Nicholas G.Orde echnology, Programming and Applications' Mc Graw Hill, 1987.	y, 'Industrial Robotics,
2. H 1	arry H. Poole, 'Fundamentals of Robotics Engineering', Van Nostran 989.	d Reinhold, New York,
REFEREN	CE BOOKS:	
1. V	.Damel Hunt, 'Smart Robots', Chappan and Hall, 1985	
2. P	.G.Ranky, C.Y.Ho, 'Robot Modeling', IFS (publication) Ltd., UK., 1985.	
3.V Ir	Venwar L. Hall, Bethe C. Hall, 'Robotics – A User Friendly Introduc Iternational Edition, Japan, 1985.	tion", Holt – Saunders

CC	OURS	E CODE:				COL	JRSE TI	TLE:			L	Т	Р	С
1	10212	2EE139			E	EMBED	DED SY	STEMS			3	0	0	3
COUR	RSE C	ATEGOR	Y: Prog	ramme	Electiv	e								
PREA	MBLE	: This (Course	aims	to ena	ble the	e stud	ents to	gain	a fair	knowle	edge c	on con	cepts,
chara	cteris	stics and	applica	ations o	of embe	edded s	system	s to Ele	ctrical	Enginee	ering a	nd also	it will	make
the st	uden	ts familia	arize w	ith real	-time.									
PRER	EQUI	SITE COL	JRSES:	Microp	rocesso	or & Mi	icrocon	trollers	5					
COUR	RSE EI	DUCATIC	NAL O	BJECTI	VES:									
The o	bject	ives of th	ne cour	se are t	:0,									
•	Te ha	ach stud rdware a	ents all and em	aspect beddec	s of the I softwa	e desigi are dev	n and d elopm	evelop ent.	ment o	of an em	bedde	d syste	m, incl	uding
•	Lea	arn and ເ	underst	and th	e chara	cteristi	cs of e	mbedde	ed syst	ems and	d its are	chitect	ures.	
•	Un	derstand	d and e	xperier	nce of s	tate of	- the -	practic	e indu	strial en	nbedde	ed syste	ems an	d
•	Un	derstand	d the o	oeratio	n of rea	al time	svstem	s.						
COUR	RSE O	UTCOM	ES:				-,							
U	pon t	he succe	essful co	omplet	ion of t	he cou	rse, stu	dents v	vill be	able to:				
со											I	Knowle	dge Le	vel
Nos	•				Cours	e Outc	omes				BI	Based (oom's	on revi Taxono	sed omv)
CO1	L	Explain t	he defi ed Syste	nitions, em.	compo	onents	and red	quirem	ents of	the			К2	
		Describe	the pro	ocessor	, archit	ecture	and m	emory	organis	ation of	f			
	<u>,</u>	the Embe	edded S	System	•								К2	
CO3	3	Develop Embedde	the inte ed Syste	erfacinį em.	g and c	ommur	nicatior	n techni	iques o	of the			КЗ	
<u> </u>	,	Explain t	, he I/O,	testing	and ap	plicati	ons of t	he Eml	bedded	1			V 2	
04	+	System.											ΝZ	
CO5	5	Describe	the de		s, chara	acterist	tics and	issues	of real	time			К2	
CORP						SOs	orreal	une a	piicati	0115				
(0)	PO1	PO2	P03	P04	P05	P06	P07	POS	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	. С.						,					. 012	1	
CO2	н										L	L	 	L
CO3	н		М	L	L	L							М	L
CO4	н	м	н	L	L	L					М	L	м	М
CO5	н	M	M		L						-	_	M	M
					-									

COURSE	CONTENT:	
UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	9
Introduct Hardware systems.	ion to Embedded Systems - definitions and constraints; Struc and Processor Requirements - Device and Device drivers - E	tures - Components - xamples of embedded
UNIT II	EMBEDDED PROCESSORS & MEMORY	9
Special Pu DSP Arch	urpose Processors - General Purpose Processors - Architectural Issue itectures - Memory - Memory Organization.	es: ARM, PIC, CISC, RISC,
UNIT III	EMBEDDED INTERFACING & COMMUNICATION	9
Memory Parallel E Commun	Interfacing - Bus, Protocols & ISA Bus Interfacing - USB Interfacin Data Communication - Serial Data Communication - Network Con Ication.	g - AD/DA interfacing - nmunication - Wireless
UNIT IV	EMBEDDED SYSTEM I/O, TESTING & APPLICATION	9
Timer – Ir - Applicat condition	nterrupts – DMA – USB & IrDA - Testing - BIST - Open-loop and Close tion Examples: Washing Machine, Automotive Systems, Auto-focus er, Elevator Control System, ATM System.	ed Loop Control Systems sing digital camera, Air-
UNIT V	REAL TIME EMBEDDED SYSTEM	9
Introduct Structure algorithm	ion - Definition & characteristics of real-time systems - Issues in real and performance measures of a real time system - Classical Uniproc s - Uniprocessor scheduling of IRIS tasks - Mode changes - Fault tole	time computing - cessor scheduling rant scheduling.
		TOTAL: 45 PERIODS
TEXT BOO	DKS:	
1. R	aj Kamal, 'Embedded Systems', Tata McGraw Hill, 1 st Edition, 2004	
2. D	avid Simon, 'An Embedded Software Primer', Addison Wesley, 2000	•
REFEREN	CE BOOKS:	
1. R	. Mall, 'Real Time Systems Theory and Practice', Pearson, 2008.	
2. Je	ean J.Labrosse, 'Embedded System Building Blocks', CMP Books, 2 nd I	Edition, 1999
3. T P	. Noergaard, 'Embedded Systems Architecture: A Comprehensive Grogrammers', Newness 2005.	Suide for Engineers and
4. D	r. Prasad, 'Embedded Real Time System', Wiley Dreamtech, 2004.	

COUI	RSE COE	DE:				COU	RSE TIT	LE:			L	т	Р	С
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COURSE	CATEGO	ORY:	Progra	mme E	lective									
PREAMB	LE: App	plicat	ion of	Electr	onic k	nowled	ge in	industr	y for	rectific	ation c	of poly	phase	supply
voltage a	nd cont	trollir	ng of m	otor sp	oeed, th	nermal	heating	д.						
PREREQU	JISITE C	OUR	SES: M	icropro	ocessor	& Micr	rocontr	ollers						
COURSE	EDUCA ⁻	TION	AL OBJ	ECTIVE	S:									
The obje	ctives o	fthe	course	are to	,									
• l	Jndersta	and a	ibout e	lectrica	al drive	system	ıs							
• 4	cquire	know	ledge	on ac a	nd dc e	, electric	drives							
• k	now th	e tra	nsient	and fre	quency	respoi	nse of a	ac and o	dc elect	tric driv	ves			
• l	Inderst	and t	he clos	ed loo	p contr	ol of el	ectrical	drives						
• k	now th	ie app	olicatio	ns of m	nicroco	ntroller	and D	SP in el	ectrica	l drives				
COURSE	ουτсο	MES												
Upor	the su	ccess	ful con	npletio	n of the	e cours	e, stud	ents wi	ll be ab	le to:				
co											k	(nowle	dge Lev	vel
Nos.					Course	e Outco	omes				(I	Based	on revis	sed
											DI	oom s	Taxono	iny)
CO1	Expla	ain al	pout th	e basic	's char	acterist	ics of e	electrica	al moto	ors.			К2	
CO2	Outli cons	ine th idera	ne type itions.	es of AC	and D	C electr	ric drive	es and i	ts stab	ility			K2	
CO3	Illust frequ	trate uency	the ph / and ti	ysical r ransien	eprese It respo	ntation onse.	of elec	trical d	rives to	o find			K2	
CO4	Expla	ain th	e close	ed loop	contro	l of ele	ctrical	drives.					K2	
CO5	Sum cont	mariz rol of	ze the a f electr	applica ical driv	tions of ves	fmicro	control	ler and	DSP ba	ased			K2	
CORRELA		OF CO	s WITH	H POs A	ND PS	Os								
COs	PO1 F	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01													Н	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н											L	Н	
CO2	Н											L	Η	
CO3	Н	М	L									М	Н	
CO4	Н	Μ	L									Μ	Η	
CO5	Н	М	L								L	М	Н	
COURSE C	ONTENT:													
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UNIT I	INTRODUCTION	9												
Electric dr motors - motors.	rive systems - solid state devices - solid state switching circuits – o speed torque characteristics of electric motors – PWM techniques	characteristics of electric - rating and heating of												
UNIT II	AC AND DC ELECTRIC DRIVES	9												
Introducti considerat stepper m	on – classification of electric drives – dynamic conditions of a tions of electrical drives – dc choppers, inverters, cycloconverter otor.	drive system – stability , ac voltage controllers,												
UNIT III	POWER CONVERTERS	9												
Induction systems, s stability of	motor drives – synchronous motor drives – dc drives – block diagrar signal flow graph representation of the systems, transient respon f controlled drives.	n representation of drive se, frequency response,												
UNIT IV	CLOSED LOOP CONTROL OF ELECTRICAL DRIVES	9												
Drive con criterion - sensitivity system de	siderations – control system components – mathematical prelimir - Assessment of relative stability using Nyquist criterion – closed log analysis in frequency domain – PID controllers – feedback comp sign.	naries – Nyquist stability op frequency response – ensation, robust control												
UNIT V	MICROCONTROLLERS AND DSP APPLICATIONS	9												
Introducti functions microcont application machine t	on – dedicated hardware system versus microcontroller control of microcontroller and dsp in drive technology – control c roller and dsp – control system design of microcontroller based ns in textile mills, steel rolling mills, cranes and hoist drives, ce ools, coal mills, paper mills, centrifugal pumps, turbo compressors.	 application areas and of electric drives using variable speed drives – ment mills, sugar mills, 												
		TOTAL: 45 PERIODS												
TEXT BOO	KS:													
1. Ve Pu	edam Subrahmanyam, 'Electric Drives – Concepts And Applicati Iblishing Company Limited, New Delhi, 2003 edition.	ons', Tata McGraw Hill												
2. Jo	hn. B. Peatman, 'Design with PIC Microcontrollers', Pearson Educatio	n, Asia 2004.												
REFERENC	E BOOKS:													
1. M Le	ohammed. A. El-Sharkawi, 'Fundamentals of Electrical Drives', earning, A Division of Thomson Learning Lin., 2001 Edition.	Books/Cole, Thomson												
2. Go Lii	opal. M, 'Control System Principles and Design', Tata McGraw I mited, New Delhi, 2 nd Edition.	Hill Publishing Company												
3. Na Ec	agrath. I. J, Gopal. M, 'Control Systems Engineering', New Age Inte lition.	ernational Publishers, 3 rd												

COURS		E• 1021	2FF1 <i>4</i> 1			COU	RSE TIT	LE:			L	Т	Р	С
COOKS		1021	222171		VI	LSI SYS	TEM &	DESIGN	J		3	0	0	3
COURS	E CATE	GORY:	Progra	mme E	lective									
PREAN comple	1BLE: T ex digita	his cou al syste	rse pro ms and	vides a the fo	an intro cus is o	oductio n CMO	n to the S techn	e desig ology.	n and i	mplem	entatio	on of V	LSI circ	uits for
PRERE	QUISIT		SES: El	ectroni	c Circui	its, Line	ar Inte	grated	Circuits	6				
COURS	E EDU		IAL OBJ	ECTIVE	S:									
The ob	jective	s of the	course	are to	,									
•	Know	the ba	sic silico	on sem	icondu	ctor teo	hnolog	y with	its phy:	sical de	sign			
•	Unde	rstand 1	the tecl	nniques	s of chi	p desig	n using	progra	mmabl	e devic	es.			
•	Acqui	re knov	vledge	on CM(OS testi	ing								
•	Unde	the co	the con	cepts c	of desig	ning VL m usin	SI subs g Hardy	ystems	ascrinti	onlan	σιιασρ			
COURS			•				gridiu				guage.			
Up	on the	succes	• sful con	npletio	n of the	e cours	e, stude	ents wil	ll be ab	le to:				
со	,									Le	vel of l	earnin	g doma	in
Nos	5.			Col	irse Ou	itcome	S			(Ва	ised on ta	xonom	a Bloor iy)	n's
CO:	1 E	xplain (CMOS T	echnol	ogy							K2		
CO	2 D	escribe	CMOS	Chip D	esign T	echniq	ues.					K2		
CO	3 E	laborat	e vario	us CMC	OS testi	ng stra	tegies.					K2		
CO4	4 D d	escribe evices	e the d	igital c	lesign	using F	Program	nmable	logic			K2		
CO	5	lustrate anguag	e the di e	gital ciı	rcuits u	sing Ha	irdware	e Descr	iption			К2		
CORRE		N OF CC)s WITH	l POs A		Os]
<u> </u>	PO1	PO2	DU3		PO5	POG	PO7	POS	POQ	PO10	PO11	PO12	DSO1	PSO2
	101	102	ros	104	FOJ	FOU	107	108	FOJ	1010	1011	1012	1301	1302
CO1	Н	M								L		L	Н	L
CO2	Н	М								L			Н	L
CO3	Н	М	М							L			н	L
	н	м	М										н	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М								L		L	Н	L
CO2	Н	Μ								L			Н	L
CO3	Н	Μ	Μ							L			Н	L
CO4	Н	Μ	Μ							L	L	L	Н	L
CO5	Н	Μ	М		L					L	L	L	Н	L

COURSE CONT	ENT:	
UNIT I	CMOS TECHNOLOGY	9
An Overview o SOI process. C rules, Stick Dia NAND, NOR, De	f silicon semiconductor technology, Basic CMOS technology ircuit Elements: Resistors, Capacitors, EAROM. Latch Up a gram, Physical Design: Basic Concepts, CAD tools. Physical esign hierarchies.	n Well, P Well, Twin Tub and nd Prevention. Layout Design Design of logic gates: inverter,
UNIT II	CMOS CHIP DESIGN	9
Logic Design w	vith CMOS: MOSFETS as switches, Basic logic gates in CM	1OS and Complex logic gates.
Transmission g	ates: Muxes and latches. CMOS chip design options: full cus	stom ASIC'S, semi-custom ASIC
and programm	nable ASIC. Programmble logic structures: 22V10, progra	mming PAL's, Programmable
interconnect R	eprogrammable GA: Xilinx programmable GA, Features an	d internal structure of CPLDs,
FPGAs, designi	ng with CPLDs and FPGAs. Introduction to IC floor planning	and testing, ASIC Design flow.
UNIT III	CMOS TESTING	9
Need for test	ing, manufacturing test principles, Design strategies for	r test: design for testability,
combinational	logic testing, sequential logic testing, fault model types, A	TPG, Boundary scan test, built
in self-test, DFT	schemes. Chip level and system level test techniques.	
UNIT IV	SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES	9
EPROM to real designing a sy introduction, S	lize a sequential circuit, Programmable logic devices: RON nchronous sequential circuit using a GAL, realization sta witching matrix, FPGA Xilinx 2000, Xilinx 3000.	1, PLA, PAL, PLD and DESIGN, te machine using PLD, FPGA:
UNIT V	SPECIFICATION USING VERILOG HDL	9
Basic concepts gate delays.	, language features, VLSI design flow, identifiers, arrays, ir	nstances, value set, ports, and
Types of Verilo descriptions.	g description – structural gate level RTL, data flow RTL and	structural and behavioral RTL
Structural gate comparator, ec	e level RTL: Half adder, Full adder, Ripple carry adder, N Juality detector, D-latch, D Flip Flop, JK flip flop.	lultiplexer, encoder, decoder,
Data flow RTL:	Operators, Combinational logic and sequential logic exampl	es.
Structural and assignments, N	behavioral RTL: Delays and Timing controls, Procedural 1ultiplexer, Combinational logic and sequential logic example	assignments and conditional es.
		TOTAL: 45 PERIODS
TEXT BOOKS:		
1. Weste	& E Shraghian 'Principles of CMOS VLSI Design' Addison We	sley, 2 nd Edition, 1993
2. Samir Educat	Palnitkar, 'Verilog HDL – Guide to Digital Design and Sy ion, 2003	nthesis', 3 rd Edition, Pearson

CO	URSE CODE:	COURSE TITLE:	L	Т	Р	,
1	0212EE142	WEARABLE ELECTRONICS	3	0	0	~~,
OURSE	CATEGORY: Program	mme Elective				
REAMB	LE: Wearable Electronic Electro	ctronics mainly deals with the fundamenta lothing product development.	als of	electror	nics and	th
REREQ	UISITE COURSES: Ba	asic Electronics and Measurement Engineering				
OURSE	EDUCATIONAL OBJ	ECTIVES:				
ne obje	ctives of the course	are to,				
• [earn about fundam	nentals of wearable technology and different int	terfacin	g techn	ologies	
• l	Jnderstand about e	lectrostatically generated nanofibers			C	
• [Describe sensing fab	pric and smart fabric for health care				
	Discuss the role of s	train sensor in wearable devices				
• L						
• l	Know the different a	applications of wearable technologies				
•	Know the different a	applications of wearable technologies				
• L • H DURSE Upor	OUTCOMES: n the successful con	applications of wearable technologies				
• I • H OURSE Upor CO Nos.	OUTCOMES:	applications of wearable technologies npletion of the course, students will be able to: Course Outcomes	Knov	wledge n revise Taxoi	Level (Ba d Bloom 10my)	ase 's
Il Id Id	OUTCOMES: n the successful con Explain the basic interfacing metho	applications of wearable technologies npletion of the course, students will be able to: Course Outcomes concept of wearable technology and different odologies.	Knov	wledge n revise Taxoi	Level (Ba d Bloom nomy) 72	ase 's
CO Nos. CO1 CO2	OUTCOMES: n the successful con Explain the basic interfacing metho Discuss about pro	applications of wearable technologies npletion of the course, students will be able to: Course Outcomes concept of wearable technology and different odologies.	Knov	wledge n revise Taxoi k	Level (Ba d Bloom nomy) (2	ase 's
• I • F • F • F • F • F • F • F • F • F • F	OUTCOMES: n the successful con Explain the basic interfacing metho Discuss about pro Describe about el	applications of wearable technologies npletion of the course, students will be able to: Course Outcomes concept of wearable technology and different odologies. oduction of nanofibres. lectroactive fabrics.	Knov	wledge n revise Taxoi k k	Level (Ba d Bloom nomy) (2 (2	ase 's
 I H DURSE Upor CO Nos. CO1 CO2 CO3 CO4 	OUTCOMES: n the successful con Explain the basic interfacing metho Discuss about pro Describe about el Outline the role o	applications of wearable technologies application of the course, students will be able to: Course Outcomes concept of wearable technology and different odologies. oduction of nanofibres. lectroactive fabrics. of strain sensors in wearable devices.	Knov	wledge n revise Taxoi k k k	Level (Ba d Bloom nomy) (2 (2 (2 (2 (2) (2)	ase 's

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L										L	Н	
CO2	Н	L						L					Н	
CO3	Н	L						L					Н	
CO4	Н	L						L					Н	
CO5	Н	L				L	L	L					Н	
1	1									1		1		

COURSE CONTEN	T:	
UNIT I	INTRODUCTION	9
Introduction - Cu Technologies-Data Implications	urrent and Future Wearable technology - Interfacing Tech a Management Technologies - Energy Management Techn	nologies-Communication ologies – Applications -
UNIT II	ELECTROSTATICALLY GENERATED NANOFIBRES	9
Introduction - Ele yarns and fabri Nanocomposites	ctrospinning Process-Background- Controlling the diameter o cs - Electroactive nanofibers - Inherently conductive p - Pyrolysis and coating of nanofibers	f the fibre- Formation of olymers and blends –
UNIT III	ELECTROACTIVE FABRICS AND WEARABLE MAN- MACHINE INTERFACES	9
Introduction- Sen capture - Smart te	sing Fabrics – Actuating fabrics- Smart Fabrics for Health care extiles for kinesthetic interfaces.	- Smart Fabric for motion
UNIT IV	STRAIN SENSORS IN WEARABLE DEVICES	9
Introduction - Tex Applications of Te	xtile Based Strain Sensors for Wearable Devices - Fabrication or xtile Based Strain Sensors	of Textile Based Sensors -
UNIT V	APPLICATIONS	9
Soldiers Status N fabric display-Con	Ionitoring Software - Design and Development of Flexible S nmunication apparel, Protection and Safety aspects of using el	olar Tent - Optical fibre ectronic gadgets
		TOTAL: 45 PERIODS
TEXT BOOKS:		
1. Xiaoming	Tao, 'Wearable Electronics and Photonics', CRC Press, 2005	
2. Subhas C. Internatio	Mukhopadhyay, 'Wearable Electronics Sensors: for Safe and He nal Publishing, 2015	ealthy Living', Springer

COURSE CODE:	COURSE TITLE:	L	т	Р	С
10212EE143	VIRTUAL INSTRUMENTATION	3	0	0	3
COURSE CATEGORY: Pr	ogramme Elective				
PREAMBLE: To study th	e concept of virtual instrumentation using software l	angua	ge		
PREREQUISITE COURSE	S: Measurement and Instrumentation				
COURSE EDUCATIONAL	OBJECTIVES:				
The objectives of the co	burse are to,				
Represent and	review signals in digital domain				
Understand the	e fundamentals of virtual instrumentation				
Familiar with th	ne standards of VI systems				
Impart the cond	cepts of graphical programming				
 Identify the ana 	alysing tools and simple programming in VI				

COURSE OUTCOMES:

• Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Represent and review signals in digital domain	К2
CO2	Describe the fundamentals of virtual instrumentation	К2
CO3	Explain about the standards of VI systems	К2
CO4	Illustrate the concepts of graphical programming	К2
CO5	Identify the analysing tools and simple programming in VI	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L											Н	
CO2	Н	L											Н	
CO3	Н	L											Н	
CO4	Н	М	L									L	Н	
CO5	Н	Н	L		М						L	М	Н	L

	ONTENT:	
UNIT I	REVIEW OF DIGITAL INSTRUMENTATION	9
Represent time – Sar	ation of analog signals in the digital domain – Review of quantiz nple and hold –Sampling theorem – ADC and DAC	ation in amplitude and
UNIT II	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	9
Concept of Resolution inputs – D card – Use	of virtual instrumentation – PC based data acquisition – Typical a and sampling frequency – Multiplexing of analog inputs – Single ifferent strategies for sampling of multi-channel analog inputs – Co of timer-counter and analog outputs on the universal DAQ card	on board DAQ card – e-ended and differential oncept of universal DAQ
UNIT III	CLUSTER OF INSTRUMENTS IN VI SYSTEM	9
Interfacing standard -	g of external instruments to a PC – RS232 – RS 422 – RS 485 – US - ISO-OSI model for serial bus – Introduction to bus protocols of MC	SB standards – IEEE 488 DD bus and CAN bus
UNIT IV	GRAPHICAL PROGRAMMING ENVIRONMENT IN VI	9
Concepts – Digital – data – Arr	of graphical programming – Lab-view software – Concept of VIs an Analog – Chart – Oscilloscopic types – Loops – Case and sequence ays – Formulae nodes – Local and global variables – String and file I	d sub VI – Display types ce structures – Types of /O
UNIT V	ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI	9
Fourier tr	ansform – Power spectrum – Correlation – Windowing and f	iltering tools – Simple
simple sec	ire indicator – ON/OFF controller – PID controller – CRO emula ond order system – Generation of HTML page	ation – Simulation of a
simple sec	ire indicator – ON/OFF controller – PID controller – CRO emula ond order system – Generation of HTML page	TOTAL: 45 PERIODS
simple sec	Ire indicator – ON/OFF controller – PID controller – CRO emula ond order system – Generation of HTML page KS:	TOTAL: 45 PERIODS
simple sec TEXT BOO 1. Gr	 Ire indicator – ON/OFF controller – PID controller – CRO emulation of order system – Generation of HTML page KS: Ipta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition strument society of America, 1994. 	ation – Simulation of a TOTAL: 45 PERIODS and Process Control',
simple sec TEXT BOO 1. Gr In 2. Pe	 Ire indicator – ON/OFF controller – PID controller – CRO emulation of order system – Generation of HTML page KS: Ipta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition strument society of America, 1994. Iter W. Gofton, 'Understanding Serial Communications', Sybex Interpreted to the strument society of America, 1994. 	ation – Simulation of a TOTAL: 45 PERIODS and Process Control', mational, 1994.
simple sec TEXT BOO 1. Gr In 2. Pe REFERENC	 Interindicator – ON/OFF controller – PID controller – CRO emulation of order system – Generation of HTML page KS: Interfacing for Data Acquisition strument society of America, 1994. Interface W. Gofton, 'Understanding Serial Communications', Sybex Interface Interf	ation – Simulation of a TOTAL: 45 PERIODS and Process Control', mational, 1994.
simple sec TEXT BOO 1. Gr In 2. Pe REFERENC 1. Ke In	In the indicator – ON/OFF controller – PID controller – CRO emula and order system – Generation of HTML page KS: Upta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition strument society of America, 1994. Inter W. Gofton, 'Understanding Serial Communications', Sybex Inter E BOOKS: Evin James, 'PC Interfacing and Data Acquisition: Technique strumentation and Control', Newnes, 2000.	ation – Simulation of a TOTAL: 45 PERIODS and Process Control', mational, 1994. es for Measurement,
simple sec TEXT BOO 1. Gr In 2. Pe REFERENC 1. Ke In 2. Ro	 Ire indicator – ON/OFF controller – PID controller – CRO emulation of der system – Generation of HTML page KS: Ipta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition strument society of America, 1994. Iter W. Gofton, 'Understanding Serial Communications', Sybex Interective BOOKS: Evin James, 'PC Interfacing and Data Acquisition: Technique strumentation and Control', Newnes, 2000. Ibbert H. Bishop, 'Learning with Lab-view', Prentice Hall of India, 2000. 	ation – Simulation of a TOTAL: 45 PERIODS and Process Control', mational, 1994. es for Measurement, 3.
simple sec simple sec TEXT BOO 1. Gr In 2. Pe REFERENC 1. Ke In 2. Ro 3. Gr Pr	 Inter indicator – ON/OFF controller – PID controller – CRO emulation of der system – Generation of HTML page KS: Ipta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition strument society of America, 1994. Inter W. Gofton, 'Understanding Serial Communications', Sybex Interester BOOKS: Interfacing and Data Acquisition: Technique strumentation and Control', Newnes, 2000. Interfacing with Lab-view', Prentice Hall of India, 2000 Interfacing Publishing, 2001. 	ation – Simulation of a TOTAL: 45 PERIODS and Process Control', mational, 1994. es for Measurement, 3. ramming', McGraw-Hill

C	COURS	SE CODE:	:			COU	RSE TIT	LE:			L	т	Р	С
	1021	2EE144			DIGI	TAL CO	NTROI	. SYSTE	MS		3	0	0	3
COURS	E CAT	EGORY:	Progra	mme E	lective									
PREAM	BLE:	This cou	rse will	supple	ement 1	the Cor	ntrol Sy	stem co	ourse i	n Progi	ram Co	re by ir	ntroduc	ing th
concep	ts of (digital co	ontrol s	ystem,	design	of con	npensa	tors in	discret	e doma	ain, for	mulatir	ng state	mode
or disc	rete t	ime syst	em and	l finally	provid	ing ide	a about	t optim	al cont	rol.				
PREREC	QUISI	re cour	SES: Lir	near Co	ontrol S	ystems								
COURS	E EDU	CATION	AL OBJ	ECTIVE	S:									
Гhe obj	jective	es of the	course	are to,	,									
•	Intro	duce ab	out digi	ital con	trol sys	stem								
•	Desi	gn comp	ensator	rs in dis	screte c	lomain								
٠	Exte	nd the kr	nowled	ge of st	tate spa	ace to c	liscrete	time s	ystem					
•	Prov	ide the b	oasics o	f Optim	nal cont	trol and	l Lyapu	nov sta	bility					
COURS		COMES												
Up	on the	e success	ful con	npletio	n of the	e course	e, stude	ents wil	l be ab	le to:				
	10				Course	Outcor	me				I	Knowle (Revise	dge Lev d Bloor	vel ns
												Тахо	nomy)	
CO1	1	Explain	the m	ethod	conve	rsion (of con	tinuous	time	to		К2	0	
		discrete	time sy	/stems	and the	e need	of digit	al cont	rol syst	em				
CO2	2	Apply th equatior	e know ns and o	vledge obtaini	of Z-tra ng the	ansform pulse tr	ns in ha ransfer	indling functio	differe ns	nce		KB	5	
COS	3	Design	n compensators via time and frequency domain							nain		K4	Ļ	
			. .						1					
CO4	4	Develop observal	state bility of	mode f discre	l and ete tim	check e syste	for co m perf	ontrolla form a	bility design	and via		K3	5	
		pole pla	cement											
COS	5	Apply tl optimal	ne app control	licatior for lin	n of Ly ear/no	/apuno onlinea	v theo r syster	rems a ns	ind ab	out		K3	5	
CORRE		N OF CC	s WITH	l POs A	ND PS	Os				L				
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	P09	PO10	PO11	PO12	PSO1	PSO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М								L	М	Н	L
CO2	Н	Н	М								М	М	Н	М
CO3	Н	Н	М	М							М	М	Н	М
CO4	Н	Н	М	М							Μ	М	Н	М
CO5	Н	Н	М								М	М	Н	М

COURSE CONT	ENT:	
UNIT I	INTRODUCTION	9
Need for digita Quantizing a Reconstructior	al Control-Signal Conversion- Discrete Time Signals- Discrete nd Quantization Error- Sampling Process-Sampling	Time system Representation- Rate Selection-Aliasing-Data
UNIT II	PULSE TRANSFER FUNCTIONS	9
Z- Transform-I Function- Puls transformatior	nverse Z Transform- Difference Equation-Mapping s-Plan ie Transfer Function of Closed Loop System- Stability i	e to z- Plane-Pulse Transfer Jury's Stability Test- Bilinear
UNIT III	DESIGN OF SAMPLED DATA SYSTEM	9
Root locus Me and Lag-Lead Practical Issues	thod – Controller Design using root locus-Nyquist Stability Compensator design in frequency domain- Design of Sys	Criteria-Bode Plot – Lag/Lead stems with Dead Beat- Some
UNIT IV	STATE SPACE MODEL FOR DISCRETE TIME SYSTEMS	9
Introduction- S versa- Solutior Pole Placemen	State Variable Representation-Conversion from state model of state difference equation- Concepts of Controllability t- State Observers	to transfer function and vice and Observability- Design Via
UNIT V	LYAPUNOV STABILITY AND OPTIMAL CONTROL	9
Stability Defir Introduction to	ition-Lyapunov Stability Theorem- Lyapunov functions Optimal Control- Performance Indices- LQR design	for linear/nonlinear system-
		TOTAL: 45 PERIODS
TEXT BOOKS:		
 Kautsh M.Gop 	iko Ogata 'Discrete Time Control Systems', Pearson Educatio al, 'Digital Control and State Variable Methods', TMH Public	on ,2 nd Edition 2015 ation, 2 nd Edition, 2014
REFERENCE BC	OOKS:	
1. B.C Ku	o 'Digital Control Systtem', Oxford University Press, 2 nd Editio	on, 2007
2. G. F. F System	Franklin, J. D. Powell and M. L. Workman, Addison Weslens', 3 rd Edition 2010	y 'Digital Control of Dynamic

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10212EE145	SYSTEMS	3	0	0	3

PREAMBLE: The basic necessity of this course arises from the fact that most of the real-world systems are highly nonlinear and handling these needs some preliminary background of these systems and its behaviour. This course introduces Nonlinear Systems in a basic level starting from one dimensional flow and ending in two dimensional flows.

PREREQUISITE COURSES: Linear Control Systems

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Impart knowledge about nonlinear systems in general
- Provide adequate knowledge in Bifurcation methods in 1 and 2 D flows
- Introduce the concepts of Chaos

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	Knowledge Level (Revised Bloom's Taxonomy)
CO1	Illustrate the importance of nonlinear Systems	К2
CO2	Explain various bifurcations methods for 1D systems	К2
CO3	Explain various bifurcations methods for 2D systems	К2
CO4	Describe the existence of limit cycles and its implications	К2
CO5	Explain about chaotic Systems	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L											Н	
CO2	Н	М	L								L	L	Н	
CO3	Н	М	L								L	L	Н	
CO4	Н	М	L								L	М	Н	
CO5	Н	М	L								L	М	Н	

COURSE	CONTENT:	
UNIT I	INTRODUCTION AND ONE-DIMENSIONAL FLOW	9
Introduct Stability-	ion to Dynamics – Importance of Nonlinear Systems-1D S Linear stability Analysis- Existence and Uniqueness- Potentials	systems- Fixed points and
UNIT II	BIFURCATIONS IN 1 D SYSTEMS AND FLOWS ON CIRCLE	9
Saddle No	ode – Transcritical – Pitch Fork –Uniform/Non uniform Oscillat	or-examples
UNIT III	2 D FLOWS	9
Linear Sys Existence	stems: Introduction – Example- Classification; Phase Plane: Int and uniqueness-Linearization-Conservative System- Reversibl	roduction- Phase portraits- e System- Index Theory
UNIT IV	LIMIT CYCLES AND BIFURCATION IN 2D	9
Introduct and Weal examples	ion- Existence of Limit Cycle- Poincare Bendixson Theorem-L kly Nonlinear Oscillator; Bifurcations: Saddle. Trans-critical, Pi - Poincare Maps	ienard Systems-Relaxation itch fork- Hopf Bifurcation-
UNIT V	INTRODUCTION TO CHAOS	9
Lorenz Eq dimensio	Juation- Properties of Lorenz Equation-Chaos on Strange attracent attracent and Maps – Fixed Points and Cobweb – logistic map- Liapunov	ctor- Lorenz Map- One and Exponent.
		TOTAL: 45 PERIODS
TEXT BOC	DKS:	
1. St E	tephen Wiggins, 'Introduction to Applied Nonlinear Dynamic dition, Springer 2010	al Systems and Chaos', 2 nd
2. Si C	teven H Strogatz, 'Nonlinear Dynamics and Chaos with applic hemistry and Engineering', Indian Edition by Levant Books, 200	cations to Physics, Biology, 07

COUR	SE CODE:				COUR	SE TITL	E:			L	Т	Р	С
1021	2EE146		DIS		3	0	0	3					
OURSE CA	TEGORY: F	Progra	mme E	lective									
REAMBLE nethods an rovides st rocessing.	: Digital Signd to acqu Sudents to	gnal Pr ire kno realize	ocessir owledg e abou	ng prov ge of an t diffen	rides an nalysis rent filf	i introd of syste ter stru	uction ems us acture a	to the ing var and als	basic co ious tra so to d	oncept ansforr evelop	s of sig nation algorit	nal pro- technic thm for	cessing ques. I r signa
REREQUIS	SITE COURS	SES: Tr	ansfori	ms and	Partial	Differe	ential E	quatio	ns.				
	OURSES: D	igital C	Control	Syster	n.								
OURSE ED	UCATIONA	AL OBJ	ECTIVE	S:									
he objecti	ves of the o	course	are to	,									
• Lea	ırn discrete	e Fouri	er tran	sform a	and its	proper	ties.						
• Stu	dy the cha	racteri	istics of	f IIR to	design	the IIR	filter.						
• Des	sign FIR Filt	ter to f	ilter th	e unde	sired si	ignals.							
• Un	derstand Fi	inite w	ord ler	ngth ef	fects &	DSP Pr	ocesso	r.					
• Stu	dy the con	cept o	f Multi	rate Si	gnal pro	ocessin	g & its a	applica	tions.				
COURSE OI	JTCOMES:												
Upon t	he successf	ful con	npletio	n of th	e cours	e, stud	ents wi	ll be at	ole to:				
CO Nos.			с	ourse	Outcom	nes				Know on	ledge l revised Taxon	.evel (B d Bloon iomy)	ased n's
CO1 /	Apply Discr the given si	rete Fo ignals.	ourier T	ransfo	rm & F	ast Fou	urier Tr	ansforr	n for		K	3	
CO2	Develop th given speci	e Digit ficatio	tal Infir ns	nite Im	pulse R	espons	se Filter	rs (IIR)	from		K	3	
CO3	Develop the given speci	e Digit ficatio	al Infin ns	ite Imp	oulse Re	espons	e Filters	s (FIR) f	from		K	3	
CO4	Apply the and solve t	basic he fini	signal te wor	proces d lengt	sing co h effect	oncepts ts on fil	in DS ters.	P Proc	essor		K	3	
CO5	Explain the application	basics s.	s of Mı	ultirate	Signal	Proces	sing co	ncepts	& its		K	2	
ORRELATI	ON OF CO	s WITH	I POs A	ND PS	Os								
COs PO	1 PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
									1		1		

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М	М	Н								Н	
CO2	Н	Н	М	М	Н								Н	
CO3	Н	Н	М	М	Н								Н	
CO4	Н	Н	М	L	L								Н	
CO5	Н	Н	М	L	L								Н	

COURSE CONTENT:		
UNIT I	DISCRETE FOURIER TRANSFORMS	9
Introduction & Properties of DI algorithms – Decimation in Tim Filtering and correlation	T – Linear & Circular Convolution Method e – Decimation in Frequency algorithms –	ls, FFT algorithms – Radix-2 FFT -Use of FFT algorithms in Linear
UNIT II	IIR FILTER DESIGN	9
Structures of IIR – Analog filte using Impulse Invariance, Biline (LPF, HPF, BPF, BRF) filter desig	r design – Discrete time IIR filter from an ear transformation - IIR Filter structures - n using frequency translation.	alog filter – IIR filter design by Approximation of derivatives –
UNIT III	FIR FILTER DESIGN	9
Structures of FIR – Linear ph Window, Hamming Window, H	ase FIR filter - Filter design using windo anning Window) - Frequency sampling teo	owing techniques (Rectangular chniques, FIR Filter structures.
UNIT IV	FINITE WORDLENGTH EFFECTS & DSP PROCESSOR	9
Finite word length effects: C coefficient quantization error scaling. Introduction to DSP ar Advanced addressing modes –	uantization- Truncation and Rounding – Product quantization error - Overflow chitecture – Harvard architecture - Dedica Pipelining - Overview of instruction set of	errors - Quantization noise – error – limit cycle oscillations, ated MAC unit - Multiple ALUs - TMS320C5X and C54X.
UNIT V	MULTIRATE SIGNAL PROCESSING & APPLICATIONS	9
Multirate signal processing: De Application - Sub band coding - Oversampling A/D &D/A.	cimation, Interpolation - Sampling rate co Musical Sound Processing - Digital Audio	nversion by a rational factor – sampling rate conversion -
		TOTAL: 45 PERIODS
TEXT BOOKS:		
 John G. Proakis & Dim Applications', 4th Editio 	itris G.Manolakis, 'Digital Signal Processi n, Pearson Education / Prentice Hall, 2007	ng – Principles, Algorithms & 7.
 B. Venkataramani, M Applications', 2nd Edition 	Bhaskar, 'Digital Signal Processors: Ann, Tata McGraw-Hill Education, 2002.	rchitecture, Programming and
REFERENCE BOOKS:		
 S.Salivahanan, A.Valla Publication, 2002. 	varaj, C Gnanapriya, 'Discrete Signal F	Processing', Tata McGraw Hill
2. Emmanuel C. Ifeacho Education / Prentice Ha	r, & Barrie.W.Jervis, 'Digital Signal Pro all, 2002.	cessing', 2 nd Edition, Pearson
3. Sanjit K. Mitra, 'Digita 2007.	l Signal Processing – A Computer Based	Approach', Tata McGraw Hill,
4. A.V.Oppenheim, R.W. Reprint, Pearson, 2004	Schafer and J.R. Buck, 'Discrete-Time	Signal Processing', 8 th Indian
5. Andreas Antoniou, "Dig	gital Signal Processing", Tata McGraw Hill,	2006.

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10212EE147	SIGNALS AND SYSTEMS	3	0	0	3

PREAMBLE: This course becomes the basis of introducing the students to the concept of signals, systems and its types, also the method of handling the signals by various mathematical tools. This course is designed pedagogically and uncovers the concepts of continuous and discrete time signals and the systems.

PREREQUISITE COURSES: Linear Control System, Engineering Mathematics

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Introduce signals (Continuous and discrete), systems (Continuous and discrete), its types and operation on signals
- Provide an intuitive understanding of the application of Fourier Series, Fourier Transforms (Including DFT) and Z-transforms
- Show the applications of these mathematical tools in networks

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Classify the various types of signal and systems and operate on the signals (like shifting, scaling etc).	К2
CO2	Apply Fourier series and Fourier transforms in the analysis of signals.	К3
CO3	Identify the significance of Laplace Transforms and apply the same to some basic circuits.	К3
CO4	Explain the concept of sampling.	К2
CO5	Apply the Z-Transforms technique to DT signal.	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	М	L								L	М	Н	L
CO2	н	М	М	L							L	М	Н	L
CO3	н	М	М	L							L	М	Н	L
CO4	н	М	L								L	М	Н	L
CO5	н	М	М								L	М	Н	L

COURSE C	CONTENT:							
UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9						
Introducti sampling- Discrete T	Introduction to Continuous and Discrete Time Signals- Continuous to Discrete transformation- sampling-Classifications of Continuous and Discrete time signal-Introduction to Continuous and Discrete Time systems and its Classification- LTI System- Impulse response							
UNIT II	FOURIER SERIES ANALYSIS	9						
Introducti Symmetry	on to Fourier Series-Trigonometric Coefficients- Evaluation of Conditions – Discrete time Fourier Series-Application of Fourier Se	Fourier Coefficients - ries to networks						
UNIT III	FOURIER TRANSFORMS	9						
Represent Transform Transform	ation of a periodic signals- Continuous time Fourier Transform ns-Discrete Time Fourier Transforms - Properties of DTFT-Dual n Pairs	- Proper ties of Fourier ity- Fourier Series and						
UNIT IV	LAPLACE TRANSFORMS	9						
Fourier to Laplace Tr	Laplace and Motivation-Region of Convergence - Properties of Lap ransforms- Application to Circuits	lace Transforms-Inverse						
UNIT V	Z- TRANSFORMS	9						
Introducti of Z-trans	on-Region of Convergence- Relation Between s and z Plane- Z-trans forms to Discrete time systems-	form Pairs- Application						
		TOTAL: 45 PERIODS						
TEXT BOO	NKS:							
1. B.	P. Lathi, 'Principles of Linear Systems and Signals', 2 nd Edition, Oxfo	ord, 2009.						
2. Al	lan V.Oppenheim, S.Wilsky and S.H.Nawab, 'Signals and Systems', F	Pearson, 2007.						
REFERENC	CE BOOKS:							
1. R. Pe	E.Zeimer, W.H.Tranter and R.D.Fannin, 'Signals & Systems - Co earson, 2007.	ntinuous and Discrete',						
2. Jo	hn Alan Stuller, 'An Introduction to Signals and Systems', Thomson	, 2007.						
3. M M	J.Roberts, 'Signals & Systems Analysis using Transform Meth cGraw Hill, 2007.	nods & MATLAB', Tata						

SUPLICING 3 0 0 1 DURSE CATEGORY: Programme Elective REAMBLE: This course becomes the basis of introducing the students to the concept soft computing techniques. REREQUISITE COURSES: Nil DURSE EDUCATIONAL OBJECTIVES: ne objectives of the course are to, • Understand about the basics of soft computing techniques with its applications. DURSE OUTCOMES: con the successful completion of the course, students will be able to: CO Course Outcomes Nos. Course Outcomes CO2 Describe the neural network concepts K2 CO3 CO4 Illustrate the basic concepts of genetic algorithm K2 CO4 CO5 Describe about hybrid soft computing techniques and its applications K2 CO5 Describe about hybrid soft computing techniques and its applications K2 CO5 Describe about hybrid soft computing techniques and its applications K2 CO5 Describe about hybrid soft computing techniques and its applications K2 CO5 Describe about hybrid soft computing techniques and its applications K2 CO5 <th></th> <th>IRSE CODE:</th> <th></th> <th></th> <th></th> <th>KSE III</th> <th></th> <th></th> <th></th> <th></th> <th>-</th> <th>Г </th> <th></th>		IRSE CODE:				KSE III					-	Г 	
COURSE CATEGORY: Programme Elective REAMBLE: This course becomes the basis of introducing the students to the concept soft computing techniques. REREQUISITE COURSES: Nil DURSE EDUCATIONAL OBJECTIVES: ne objectives of the course are to, • Understand about the basics of soft computing techniques with its applications. DURSE OUTCOMES: non the successful completion of the course, students will be able to: CO Course Outcomes Nos. Kanowledge Level (Basection on revised Bloom's Taxonomy) CO1 Explain the basics of soft computing techniques K2 K2 CO3 Explain about the fuzzy logic concepts CO4 Illustrate the basic concepts of genetic algorithm K2 K2 CO5 Describe about hybrid soft computing techniques and its applications K2 K2 CO5 Describe about hybrid soft computing techniques and its applications K2 K2 CO4 Explain about the fuzzy logic concepts K2 K2 CO4 Illustrate the basic concepts of genetic algorithm K2 CO5 Describe about hybrid soft computing techniques and its applications <tr< th=""><th>10.</th><th>21266148</th><th></th><th></th><th>SOFT C</th><th>OMPU</th><th>TING</th><th></th><th></th><th>3</th><th>0</th><th>0</th><th></th></tr<>	10.	21266148			SOFT C	OMPU	TING			3	0	0	
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CO2	Н	М	М								L	Μ	Н	L
CO3	Н	М	М								L	М	Н	L
CO4	Н	М	М								L	М	Н	L
CO5	Н	М	М								L	М	Н	L

COURSE CONTENT:

UNIT I INTRODUCTION

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm-Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

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McCulloch-Pitts neuron – linear separability – Hebb network – supervised learning network: perceptro networks – adaptive linear neuron, multiple adaptive linear neurons, BPN, RBF, TDNN- associativ memory network, atter-associative memory network, BAM Hopfield networks; iterative auto associative memory network, & iterative associative memory network – unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, AR network. UNIT III FUZ2Y LOGIC 9 Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy urithmetic extension principle – fuzzy measures – measures of fuzzive propositions, formation of rules-decomposition or rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy experimentary decision making. UNIT IV GENETIC ALGORITHM 9 Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle stopping condition – constraints – classification genetic programming – multilevel optimization – real life problem-advances in GA. 9 NITT V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9 Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral image with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers. TOTAL: 45 PERIOD: TOTAL: 45 PERIOD:	UNIT II	NEURAL NETWORKS	9						
UNIT III FUZZY LOGIC 9 Membership functions: features, fuzzification, methods of membership value assignments Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle – fuzzy measures – measures of fuzzy provisitions, formatire reasoning: truth values and tables, fuzzy protositions, formatine reasoning: truth values and tables, fuzzy protositions, formation or rules-decomposition c. UNIT IV GENETIC ALGORITHM 9 Genetic algorithm and search space – general genetic algorithm – operators – Generational cycle - stopping condition – constraints – classification genetic programming – multilevel optimization – real lifproblem- advances in GA. 9 UNIT V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9 Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy geneti hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral image with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers. TEXT BOOKS: 1 J.S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing', PHI / Pearson Education 2004. 2 S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: 1 1 S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Pre	McCulloc networks memory Hopfield – unsupe network.	McCulloch-Pitts neuron – linear separability – Hebb network – supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neurons, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, Hopfield networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.UNIT IIIFUZZY LOGIC9							
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 Neuro-fuzzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP – Applications: A fusion approach of multispectral image with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers. TOTAL: 45 PERIODS TEXT BOOKS: J.S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing', PHI / Pearson Education 2004. S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	UNIT V	HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS	9						
 TEXT BOOKS: 1. J.S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing', PHI / Pearson Educatio 2004. 2. S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: 1. S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. 2. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. 3. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. 4. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. 5. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	Neuro-fuz hybrid sy with SAR, based hyl	zzy hybrid systems – genetic neuro hybrid systems – genetic fuzzy stems – simplified fuzzy ARTMAP – Applications: A fusion approacl optimization of traveling salesman problem using genetic algorithm a prid fuzzy controllers.	hybrid and fuzzy genetic h of multispectral images approach, soft computing-						
 TEXT BOOKS: J.S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing', PHI / Pearson Educatio 2004. S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson Education India, 1991. 			TOTAL: 45 PERIODS						
 J.S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing', PHI / Pearson Educatio 2004. S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	TEXT BOO	DKS:							
 S.N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India Pvt Ltd, 2011. REFERENCE BOOKS: S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	1. J. 2	S.R.Jang, C.T. Sun and E.Mizutani, 'Neuro-Fuzzy and Soft Computing' 004.	, PHI / Pearson Education						
 REFERENCE BOOKS: S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	2. S	N.Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley Ir	ndia Pvt Ltd, 2011.						
 S.Rajasekaran and G.A.Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithm Synthesis & Applications', Prentice-Hall of India Pvt. Ltd., 2006. George J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and Applications' Prentice Hall, 1997. David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	REFEREN	CE BOOKS:							
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 David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	2. G H	eorge J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations a all, 1997.	and Applications' Prentice						
 James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, an Programming Techniques', Pearson Education India, 1991. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson 	3. D	 David E. Goldberg, 'Genetic Algorithm in Search Optimization and Machine Learning' Pearson Education India, 2013. 							
5. Simon Haykin, 'Neural Networks Comprehensive Foundation' Second Edition, Pearson	4. Ja P	4. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms, Applications, and Programming Techniques', Pearson Education India, 1991.							
Education, 2005.	5. Si E	mon Haykin, 'Neural Networks Comprehensive Foundation' S ducation, 2005.	econd Edition, Pearson						

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COL	JRSE CO	DDE:				COU	RSE TIT	LE:			L	Т	Р	С
10	212EE 1	EIGONSE TITLEIIIEIA9BIO MEDICAL INSTRUMENTATION300TEGORY: Programme Elective												
COURS	OURSE CATEGORY: Programme Elective													
PREAM	REAMBLE: The course is designed to make the student acquire an adequate knowledge of the													
physiol	hysiological systems of the human body and relate them to the parameters that have clinical montance. The fundamental principles of equipment that are actually in use at the present day are													
introdu	nportance. The fundamental principles of equipment that are actually in use at the present day are													
PREREC	Itroduced. REREQUISITE COURSES: Basic Electronics and Measurement Engineering													
	REREQUISITE COURSES: Basic Electronics and Measurement Engineering													
		ATION	AL UD.		_3.									
The obj	ectives	orthe	course	e are to	,									
•	Provid	e an ao ation.	cquaint	ance o	f the p	hysiolo	ogy of t	he hea	rt, lung	, blood	circula	ation a	nd circ	ulation
•	Introd	uce the	e meth	ods of	differe	nt tran	sducer	s used.						
•	Provid	e the l	atest ic	leas on	device	es of no	on-elec	trical d	evices.					
•	Provid	e lates	t know	ledge	of Pulm	nonary	Measu	remen	t & Bio	Telem	etry			
•	Bring	out the	impor	tant ar	nd mod	ern me	ethods	of imag	ging teo	chnique	es.			
COURS	Ε Ουτά	OMES	:											
Upo	on the s	success	sful cor	npletio	on of th	e cour	se, stud	dents w	ill be a	ble to:				
со				c	ourse	Outcor	nos				Know	ledge L rovisor	.evel (E I Bloon	ased
Nos.					Jourse	outtoi	nes				on	Taxon	omy)	13
CO1	. Ex	plain a	bout th	ie fund	ament	als of b	oiomed	ical en	gineeri	ng		K	2	
	Ex	plain	about	the	basic	s of	vario	us se	nsing	and				
	me	easure	ment d	evices								К.	2	
CO3	illu	ustrate	the lat	est ide	as on c	levices	of non	-electr	ical dev	vices		K	2	
	٨٥	oly th	a lator	t know	lodgo	of Dul	monan	/ Moas	uromo	nt &				
CO4	Bio	o Telen	netry		neuge	or Full	monary	/ IVICas	urenie	in a		K	3	
C05	De	scribe	about	the m	odern	metho	ds of ir	naging	techni	ques		K	2	
	an	d biom	etric sy	ystem									_	
CORREL	ATION	OF CC	os WITI	H POs A	AND PS	5Os			<i></i>					
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L										L	M	
CO2	Н	L										L	М	
CO3	Н	L	L								L	L	М	L
CO4	Н	L										L	М	

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CO5

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COURSE C	ONTENT:	
UNIT I	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	9
Cell and i biomedica mechanics transduce	ts structure – Resting and Action Potential – Nervous system - I system- Cardiovascular systems- Respiratory systems - Biomecha of spinal column and limbs- Transducers – selection criteria – rs - Temperature measurements - Fibre optic temperature sensors	- Basic components of a nics of soft tissues - Basic Piezo electric, ultrasonic
UNIT II	BIOMEDICAL MEASUREMENT	9
Electrodes shock has equipmen	5 –types-Amplifiers - ECG – EEG – EMG – ERG - Electrical safety zards – leakage current-Instruments for checking safety pa ts.	in medical environment, rameters of biomedical
UNIT III	NON-ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES	9
Measuren measuren pH of bloc	nent of blood pressure - Cardiac output - Heart rate - Heart sou nents – spirometer – Photo Plethysmography, Body Plethysmograp nd –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, G	nd - Pulmonary function hy – Blood Gas analysers, SR measurements.
UNIT IV	PULMONARY MEASUREMENT AND BIO TELEMETRY	9
Physiology Bioteleme hazards ar	v of respiratory system – Respiratory rate measurement – wire and try – Telemetering multiple information – implanted transmitten nd safety techniques.	wireless ers – causes of electrical
UNIT V	MEDICAL IMAGING SYSTEM	9
Ultrasoun Cine angio	d scanner – Echo cardiography – Coloar Doppler system – CAT and gram – LASER Imaging – Endoscope.	l CT scan – MRI Imaging –
		TOTAL: 45 PERIODS
TEXT BOO	KS:	
1. Le De	slie Cromwell, 'Biomedical Instrumentation and Measurement', Pelhi, 2007.	rentice Hall of India, New
2. Jo W	seph J.Carr and John M. Brown, 'Introduction to Biomedical Equi ileyand sons, New York, 4 th Edition, 2012.	pment Technology', John
REFERENC	E BOOKS:	
1. Jo Ne	hn G. Webster, 'Medical Instrumentation Application and Designew York, 1998.	n', John Wiley and Sons,
2. Kh Ec	andpur R.S, 'Handbook of Biomedical Instrumentation', Tata Mc lition, 2003.	Graw-Hill, New Delhi, 2 nd
3. Di	uane Knudson, 'Fundamentals of Biomechanics', Springer, 2 nd Edition	on, 2007.
4. Ec		
Pr	l. Joseph D. Bronzino, 'Biomedical Engineering Hand Book', Third ess LLC, 2006.	Edition, Boca Raton, CRC

С	OURSI 10212	E CODE EE150	:		PR	COU	RSE TIT	ΈΕ: ΜΑΤΙΟΙ	N	_	L 2	T	P	C
COURS	SE CAT	EE150 PROCESS AUTOMATION 3 0 0 3 EGORY: Programme Elective												
PREAM technic	PREAMBLE: This course is designed to provide the knowledge on recent trends in automation techniques (Programmable Logic Controllers & Distributed Control Systems deployed in the various core industries and research organization).													
PRERE	QUISIT	E COUI	RSES: D	igital Lo	ogic Ciro	cuits								
COURS	SE EDU	CATION	NAL OB.	IECTIVE	S:									
The ob	jective	es of the	e course	e are to	,									
•	Reali mana Relat	ze the v aging te e the a	vorking chnique utomat	, desigr es. ion tecł	n and no	eed of	timers, I world	counte engine	ers, vari	ous me pplicat	emories	s and th	eir effi	cient
COURS	SE OUT	COMES succes	5: sful cor	npletio	n of the	e cours	e, stude	ents wi	ll be ab	le to:				
CC) s.				Cour	se Out	comes					Level o domair revise	of learn 1 (Based d Bloon	ing d on n's)
СО	1	llustrat	e the b	asics of	PLCs								K2	
CO	2	Design	Ladder	Diagrar	n by pr	ogramı	ning th	e timer	s and c	ounter	s.		К3	
CO	3	Design	the PLC	s addre	ssing a	pplicati	ions an	d resea	rch pro	blems.			КЗ	
CO	4	Exempl	ify the <code>k</code>	basics a	nd desi	gn of D	CS						КЗ	
CO	5	Integrat	ting var	ious co	mpone	nts to [DCS to e	execute	Autom	nation			К2	
CORRE			Os WITI			0s								
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L	М	М							L	м	н	L
CO2	Н	Н	М	н								L	н	
CO3	Н	L	L	М								L	Н	L
CO4	Н	L	М	М							L	М	Н	L
CO5	Н	М	L									L	Н	
COURS		ITENT:												
UN	UNIT I PROGRAMMABLE LOGIC CONTROLLER 9													
Evoluti	Evolution of PLC's – Components of PLC – Advantages over relay logic - PLC programming languages													
UNI	UNIT II PROGRAMING IN PLC 9													
Ladder	Ladder diagram – Programming timers and counters – Design of PLC.													

UNIT III	APPLICATIONS OF PLC	9					
Instructions in PLC – Program control instructions, math instructions, sequencer instructions – Use of PC as PLC – Application of PLC – Case study of bottle filling system							
UNIT IV	DISTRIBUTED CONTROL SYSTEMS (DCS)	9					
Definition, arc languages, LCU	hitecture (centralized, hybrid generalized DCS) Local Control J – Process interfacing issues, communication facilities, config	Unit (LCU) architecture, LCU guration of DCS.					
UNIT V	INTERFACES IN DCS	9					
Operator inte interfaces – Lo	rfaces - Low level and high-level operator interfaces – Open with level and high-level engineering interfaces – General purpo	erator displays - Engineering ose computers in DCS.					
		TOTAL: 45 PERIODS					
TEXT BOOKS:							
1. Frank Public	Petruzella, 'Programmable Logic Controllers', 3 rd Editio ations, 2010	on, by, Tata McGraw Hill					
2. Georg	e Bolton, 'Programmable Logic Controllers', 5 th Edition, Elsevi	er India Publications, 2008					
REFERENCE BO	DOKS:						
1. Webb	John W, Reis Ronald A, 'Programmable Logic Controllers', PH	l learning Pvt Ltd.,2007					
2. Hackw Edition	orth, 'Programmable Logic Controllers: Programming Me n, Pearson India Publications.	thods and Applications', 1 st					

СС	DURSE	CODE:				СС	OURSE T	TITLE:				L	T I	þ	С
1	.0212E	L2EE151 UTILIZATION OF ELECTRICAL ENERGY 3 0 0 3 ATEGORY: Programme Elective													
COURS	COURSE CATEGORY: Programme Elective														
PREAN	PREAMBLE: This course will provide knowledge on illumination of lighting, Traction, Electrical heating,														
	Electro mechanical energy conversion and various electrical loads.														
COURS	E EDU		IAL OB.		S:										
The ob	jective	s of the	course	are to,	,			· · · ·							
•	and d	esired	rious m applicat	lethods tions	of effe	ctively	and eff	riciently	/ utilizii	ng Elect	rical Ei	nergy	or di	fere	ent
•	Teach	the va	rious El	ectrica	l Lightir	ng prin	ciples a	nd thei	r applio	cations.					
•	Impai Mech	t know anical p	ledge corocess	on effec	tive uti	lizatior	n of Eleo	ctrical D	Drives,	Electric	al Trac	tion ar	d Elec	ro	
COURS	E OUT	COMES	:												
Up	on the	succes	sful cor	npletio	n of the	e cours	e, stude	ents wil	ll be ab	le to:					
со					C	0					d	Level o omair	of learr (Base	ing d or	•
Nos.					Course	Outco	mes					revise tax	d Bloo	n's	
C01	De	termine	e of MH	ICP and	MSCP	of vario	ous ligh	ting sys	stem.				K2		
C02	Illu	strate t	the Elec	tric He	ating, V	Velding	g & Furr	nace pr	ocess				K2		
C03	Sel	ect the	e drive	s base	d on a	applica	tion, C	alculat	ion of	Power			к2		
	Ree	quirem	ent for	motor	load uti	ilizatior	n.						N2		
C04	ap	strate i plicatio	the role n.	e and re	equiren	nent of	electri	cal ene	rgy in t	traction			К2		
C05	Exp	olain th	e Elect	ro Mec	hanical	Proce	ss and	Calcula	tion of	Energy	,		к2		
	Ree	quirem	ents												
CORRE	LATIO	N OF CO	Ds WITH	l POs A	ND PS	Os	1	ſ	Γ			1	1		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	. PS	502
CO1	Н	М	L								L	М	н		
CO2	Н	М										М	н		
CO3	Н	H M L L M H													
CO4	Н	М	L								L	М	н		
CO5	Н	М										М	Н		
															—

UNIT I	ILLUMINATION	9						
Production of light – Det Rousseau's construction - lamps – Gaseous discharg	ermination of MHCP and MSCP – Polar curves of diffe - Lighting schemes and calculations – Factory lighting – ge – High pressure and low pressure.	rent types of sources – Flood lighting – Electric						
UNIT II ELECTRIC HEATING AND WELDING 9								
Resistance, Inductance a efficiency - High frequenc welding – spot welding.	nd Arc furnaces – Construction and fields of applicatio y - Dielectric heating – Characteristics of carbon and me	n – Losses in oven and tallic arc welding – butt						
UNIT III	ELECTRIC DRIVES AND CONTROL	9						
Group drive – Individual characteristics - Mechan Choice of drives – power	drive – selection of motors – starting and running c ical features of electric motors – Drives for different i requirement calculation – power factor improvement.	haracteristics – Running ndustrial applications -						
UNIT IV	ELECTRIC TRACTION	9						
Traction system – Speed time characteristics – Series and parallel control of D.C motors -Open circuited, shunt and bridge transitions – Tractive effort calculation – Electric braking – Tramways and trolley bus – A C traction and recent trend - Magnetic devitation								
A.C traction and recent tr	A.C traction and recent trend - Magnetic devitation							
A.C traction and recent tr	end - Magnetic devitation ELECTROMECANICAL PROCESSES	9						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries –Lead acid b batteries – Battery charge	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – N patteries, Components and materials – Chemical reaction es.	9 Ind other equipments – Ii-iron and Ni- cadmium ons – Capacity rating of						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries –Lead acid b batteries – Battery charge	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – N patteries, Components and materials – Chemical reactions es.	9 Ind other equipments – Ii-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries –Lead acid b batteries – Battery charge TEXT BOOKS:	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – N batteries, Components and materials – Chemical reaction es.	9 Ind other equipments – Ii-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries –Lead acid b batteries – Battery charge TEXT BOOKS: 1. Uppal S.L, 'Electri	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – Notatteries, Components and materials – Chemical reactiones. c Power', Khanna Publishers, 1988	9 Ind other equipments – Ii-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries – Lead acid b batteries – Battery charge TEXT BOOKS: 1. Uppal S.L, 'Electri 2. Open Shaw Taylo Units), 1971.	end - Magnetic devitation ELECTROMECANICAL PROCESSES a factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – Notatteries, Components and materials – Chemical reactiones. c Power', Khanna Publishers, 1988 or, 'Utilization of Electrical Energy', Oriented Longmans	9 Ind other equipments – Ii-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries – Lead acid b batteries – Battery charge TEXT BOOKS: 1. Uppal S.L, 'Electri 2. Open Shaw Taylo Units), 1971. REFERENCE BOOKS:	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – N patteries, Components and materials – Chemical reaction es. c Power', Khanna Publishers, 1988 or, 'Utilization of Electrical Energy', Oriented Longmans	9 Ind other equipments – li-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries – Lead acid b batteries – Battery charge TEXT BOOKS: 1. Uppal S.L, 'Electri 2. Open Shaw Taylo Units), 1971. REFERENCE BOOKS: 1. Alexander Kusko	end - Magnetic devitation ELECTROMECANICAL PROCESSES factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – N patteries, Components and materials – Chemical reaction es. c Power', Khanna Publishers, 1988 or, 'Utilization of Electrical Energy', Oriented Longmans 'Power Quality in Electrical Systems', McGraw-Hill Profes	9 Ind other equipments – li-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS s Limited (Revised in SI						
A.C traction and recent tr UNIT V Electrolysis – polarization Calculation of energy req batteries – Lead acid b batteries – Battery charge TEXT BOOKS: 1. Uppal S.L, 'Electri 2. Open Shaw Taylo Units), 1971. REFERENCE BOOKS: 1. Alexander Kusko 2. Soni A. Chakrab Enggineering', Kh	end - Magnetic devitation ELECTROMECANICAL PROCESSES a factor – preparation work for Electro plating – Tanks a uirements – Methods of charging and maintenance – Notatteries, Components and materials – Chemical reactiones. c Power', Khanna Publishers, 1988 or, 'Utilization of Electrical Energy', Oriented Longmans 'Power Quality in Electrical Systems', McGraw-Hill Profese arti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A Text Boarna Publishers, 2000.	9 Ind other equipments – li-iron and Ni- cadmium ons – Capacity rating of TOTAL: 45 PERIODS s Limited (Revised in SI ssional, 2007 ook on Power System						

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10212EE152	ENERGY AUDITING AND MANAGEMENT	3	0	0	3
COURSE CATEGORY: Pro	ogramme Elective				
PREAMBLE: This course energy audit.	will helps to understand the various terms and me	thodol	ogy ass	ociate	d with
PREREQUISITE COURSES	S: Nil				
COURSE EDUCATIONAL	OBJECTIVES:				
The objectives of the co	urse are to,				
Understand the	concept of energy auditing and its importance				
Acquire knowled	dge on finance management				
Understand the	importance of energy efficient electrical system				
COURSE OUTCOMES:					
Upon the successful	completion of the course, students will be able to:				
		evel of	learnir	ng dom	ain

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Describe energy scenario nationwide and worldwide	К2
CO2	Outline the energy management and audit methods	К2
CO3	Summarize financial management and Energy performance contracts	К2
CO4	Explain energy related aspects of electrical system	К2
CO5	Illustrate studies related to operational aspects of compressed air system	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н					L		L					Н	L
CO2	Н	Н	М			М			L		L	L	Н	L
CO3	Н	Н				М			L		L	L	Н	L
CO4	Н	Н	М			М	L						Н	L
CO5	Н	Н	М			М	L						Н	L

COURSE CON	TENT:	
UNIT I	ENERGY SCENARIO	9
Energy scenar Energy securit	io of growing economy, Energy pricing, Energy sector reforms, Energy a y, Energy conservation and its importance, Energy conservation Act-2001	nd environment, and its features
UNIT II	ENERGY MANAGEMENT AND AUDIT	9
Energy audit- costs, Bench i efficiencies, C instruments	need, Types of energy audit, Energy management (audit) approach-unde marking, Energy performance, Matching energy use to requirement, ma Optimizing the input energy requirements, Fuel and energy substitution	rstanding energy aximizing system on, Energy audit
Material and diagrams.	Energy Balance: Methods for preparing process flow, Material and	energy balance
UNIT III	FINANCIAL MANAGEMENT	9
Investment-ne Financing opti	eed, Appraisal and criteria, financial analysis techniques- Risk and ser ons, Energy performance contracts and role of ESCOs.	nsitivity analysis,
UNIT IV	ELECTRICAL SYSTEM	9
Electricity tari induction mo motors. Light	ff, Load management and maximum demand control, T&D losses. Losses tors, Factors affecting motor performance and remedial solutions, source, Choice of lighting, Luminance requirements, and Energy conserva	and efficiency in energy efficient tion avenues
UNIT V	COMPRESSED AIR SYSTEM	9
Types of air co system compo HVAC and Re Capacity, perf principle, Savi	ompressors, Compressor efficiency, Efficient compressor operation, Components, Capacity assessment. frigeration System: Vapour compression refrigeration cycle, Coefficient formance and savings opportunities, Vapour absorption refrigeration sing potential, Fans, Blowers and pumps- Types, Performance evaluation	oressed air of performance, system: Working on, Flow control
	TO	TAL: 45 PERIODS
TEXT BOOKS:		
1. Abbi, Books	Y.P. and Jain, S., 'Handbook on Energy Audit and Environment Ma tore, 2006.	nagement', Teri
REFERENCE B	OOKS:	
1. Young	er, W., 'Handbook of Energy Audits', CRC Press. 2008.	
C		

		COURSE TITLE:	L	Т	Р	С
1	0212EE153	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	3	0	0	3
COURSE	CATEGORY: Progra	mme Elective	·			
PREAM	BLE: This course will	helps to know the basic concepts of electrical safe	ety and r	egulatio	ons	
PREREQ	UISITE COURSES: Ni	1				
COURSE	EDUCATIONAL OBJ	ECTIVES:				
The obje	ectives of the course	are to make the students,				
•	To study the elect improvement.	rical safety rules, regulations and quality mana	gement	by the	power	factor
COURSE	OUTCOMES:					
	Upon the successful	completion of the course, students will be able to):			
CO Nos.		Course Outcomes	Knowle revised	edge Lev Bloom	vel (Base 's Taxon	ed on omy)
CO1	Explain Indian elec	tricity rules and acts and their significance		K2	2	
CO2	Illustrate the need	of electrical safety in different locations		K2	2	
CO3	Outline the need of equipment's	f electrical safety during installation of		K2	2	
CO4	Explain the necess	ity of electrical safety in Hazardous zones		K2	2	
CO5	Describe the elect	rical safety in distributed systems		K2	2	
		· · · · · · · · · · · · · · · · · · ·				
CORREL	ATION OF COs WITH	POs AND PSOs				

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	М	L			М		М			L	М	Н	
CO2	н	М	L			М		L				L	Н	
CO3	н	М	L			М					L	L	Н	
CO4	н	М	L			М		L			L	L	Н	
CO5	Н	М	L			М						L	Н	

COURSE CONTENT:

INDIAN ELECTRICITY RULES AND ACTS AND THEIR SIGNIFICANCE

9

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and firefighting facility.

UNIT II	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS	9
Wiring and fitt multi-storied b in the use of d	ing – Domestic appliances – water tap giving shock – shock from puilding – Temporary installations – Agricultural pump installation omestic electrical appliances.	n wet wall – fan firing shock – n – Do's and Don'ts for safety
UNIT III	SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE	9
Preliminary pr quality and sa safeguards for	eparations – safe sequence – risk of plant and equipment – s afety - personal protective equipment – safety clearance no operators – safety	afety documentation – field tice – safety precautions –
UNIT IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS	9
Hazardous zor Specifications enclosure for locations.	es – class 0,1 and 2 – spark, flashovers and corona discharge an of electrical plants, equipments for hazardous locations – various hazardous gases and vapours – classification of equipm	nd functional requirements – Classification of equipment ent/enclosure for hazardous
UNIT V	ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM	9
Total quality co – Causes of low	ontrol and management – Importance of high load factor – Disad v P.F. – power factor improvement – equipments – Importance o	vantages of low power factor f P.F. improvement
		TOTAL: 45 PERIODS
TEXT BOOKS:		
1. Rao, S Publisl	. and Saluja, H.L., 'Electrical Safety, Fire Safety Engineering and S ners, 1988.	Safety Management', Khanna
2. Pradee Compa	ep Chaturvedi, 'Energy Management Policy, Planning and Uti any, 1997	lization', Concept Publishing

COURSE CODE:	COURSE TITLE:	L	Т	Ρ	С
10212EE154	RENEWABLE ENERGY SOURCES	3	0	0	3
COURSE CATEGORY: Prog	ramme Elective				
DDEAMBLE. This source	focusos on the new renewable energy based	alaatria	0005	<i></i>	oration

PREAMBLE: This course focuses on the new renewable energy based electric energy generation technologies and their integration into the power grid. The principals of new energy based distributed generation technologies: solar, wind, and fuel cells.

PREREQUISITE COURSES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Introduce about the renewable energy sources like wind, solar and wave energy.
- Impart knowledge about the environment friendly energy production and consumption.
- Explain about energy-efficient systems and products for various applications.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain about Renewable Energy resources and importance.	К2
CO2	Outline the process of photovoltaic power generation.	К2
CO3	Outline the process of power generation using wind energy sources.	К2
CO4	Describe the biomass and biogas production techniques.	К2
CO5	Explain the fundamentals and applications of Geothermal energy, tidal energy, MHD and fuel cells.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	н	М	М								М	М	Н	
CO2	н	М	М								М	М	Н	L
CO3	н	М	М								L	L	Н	L
CO4	н	М	М									L	Н	L
CO5	Н	М	Μ									L	Н	L

COURS	e co	NTENT:	
UNIT	1	INTRODUCTION	9
World o utilizati	ener ion-r	gy use-reserves of energy resources-energy cycle of the earth-envirc enewable energy resources and their importance.	onmental aspects of energy
UNIT	П	SOLAR ENERGY	9
Basic co heat tr semi- c	once ansp ondu	pts, solar thermal systems and solar ponds, solar thermal central re ort system, thermal storage systems, photovoltaic energy conversi ictors, solar cell, batteries, satellite solar power systems.	eceiver systems, heliostats, on, solid - state principles,
UNIT	ш	WIND ENERGY	9
Principl new de system	les o evelo s.	f wind power, wind turbine operation, site characteristics, horizon pments, small and large machines, magnus effect, design principle	tal and vertical axis types, s of wind turbine, storage
UNIT	IV	BIOMASS AND BIOGAS	9
Concep biomas enviror liquefac process	ots and s resonment ction ses, c	nd systems, biomass production, energy plantation, short rotation source agro forestry wastes, municipal solid wastes and agro pro- tal factors and biomass energy development, combustion, p , modeling, appliances and latest development, bioconversion: bio hemicals from biomass and biotechnology.	n species, forestry system, cessing industrial residues, pyrolysis, gasification and gas, fermentation and wet
UNIT	v	OTHER RENEWABLE ENERGY SOURCES	9
Geothe applica Magne hydel s	ermal tions to Hy yster	energy, types, systems and application, Ocean thermal ene . Wave energy - types, systems and applications. Tidal energy - types /drodynamic system (MHD). Fuel cells – types and applications, hyd ns. Hybrid systems and applications	ergy, types, systems and s, systems and applications. rogen technologies. Micro-
			TOTAL: 45 PERIODS
TEXT B	οοκ	S:	
1. 2.	Rai otha PHI	G D, 'Non-Conventional Sources of Energy', Khanna Publishers, 2006. ari P, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources ar Pvt. Ltd., New Delhi, 2008.	nd Emerging Technologies',
REFERE	NCE	BOOKS:	
1.	KSu McQ	khatme S P and Nayak J K, 'Solar Energy - Principles of Thermal Co Graw Hill, 2008.	ollection and Storage', Tata
2.	Frar Pres	nk Kreith and Yogi Goswami D, 'Handbook of Energy Efficiency an ss, 2007.	d Renewable Energy', CRC
3.	Ben	t Sorensen, 'Renewable Energy', Academic Press, 2004.	
4.	Abb Priv	asi S A and Naseema Abbasi, 'Renewable Energy Sources and their ate Limited, 2001.	Environmental Impact', PHI

C	OURSE	CODE:				COU	RSE TIT	LE:			L	Т	Р	С
:	10212E	E155			SO	LAR ELE	ECTRIC S	SYSTEM	IS		3	0	0	3
COURS	SE CAT	EGORY:	Program	nme El	ective									
PREAN	MBLE:	This co	urse he	lps to	unders	stand S	olar Ce	lls and	Its Te	chnolog	gies, Ph	otovoli	taic Pri	nciples
Fabrica	ation T	echnolo	gy											
PRERE	QUISIT	e cour	SES: Nil	l										
COURS	SE EDU	CATION	AL OBJ	ECTIVE	S:									
The ob	ojective	s of the	course	are to,										
•	Intro	duce ab	out the	renewa	able en	ergy sou	urces lik	e wind,	, solar a	ind wav	e energ	gy.		
•	Impa	rt know	ledge al	bout th	e enviro	onment	friendl	y energ	y produ	iction a	nd cons	sumptic	on.	
COURS	SE OUT	COMES	:											
Up	oon the	success	sful com	pletior	of the	course,	, studer	nts will b	be able	to:				
CO Nos	5.			С	ourse C	Dutcom	es			K re	(nowled evised I	dge Lev Bloom's	el (Base s Taxon	ed on omy)
CO	1 E	xplain a	bout so	lar ene	rgy and	its tech	nnologie	es				К2		
CO2	2 0	utline t	he phot	ovoltai	c princi	ples						K2		
COS	3 E	xplain tl	ne solar	cell fat	oricatio	n techn	ology					K2		
CO4	4 P	redict tl	ne perfo	ormance	e of sola	ar array	system	1				K2		
CO	5 S	ummari	ze the a	pplicat	ions of	solar pł	notovoľ	taic syst	tem			K2		
CORRE	ει ατιο)s W/ITH	ΡΩς Δ)c								
							007	DOS	DOC	DO10	DO11	DO1 2		
CUS	104	PU2	PU3	PU4	PU5	PU6	P07	804	P09	1010	1001	1012	2201	P302
CO1	Н	Μ	L								L	M	Н	

COURSE CONTENT:

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CO2

CO3

CO4

CO5

UNIT I SOLAR CELLS AND ITS TECHNOLOGIES

Solar cells: working of solar cells, I-V characteristics, conversion efficiency, losses in solar cells, high efficiency solar cells, quantum dots, multi junction solar cells.

Solar cell technologies: Material selection, solar cell fabrication, amorphous, single and poly crystalline silicon solar cells, thin film solar cells, organic solar cells, first-, second- and third-generation solar cells, advantages, drawbacks, latest developments; concentrated PV systems. Testing, standardization and evaluation of solar cells.

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ANCIPLES nomo and heterojunctions, Metal-semiconductor ircuit of the Solar Cell, Analysis of PV Cells: Dark of solar cell; Efficiency limits; Variation of efficier ements; High efficiency cells, Types of Solar cells. CATION TECHNOLOGY electronic and solar grade Silicon; Production Z) method: Procedure of masking, photolithogra ar cell; High efficiency III-V, II-VI multi-junction s termo-photovoltaics. TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detaid Maximum tracking; Use of computers in array de- noting.	9 r interface; The and illumination hey with band-gap and 9 n of single crystal Silicon: aphy and etching; Design of colar cell; a-Si-H based solar 9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
nomo and heterojunctions, Metal-semiconductor ircuit of the Solar Cell, Analysis of PV Cells: Dark of solar cell; Efficiency limits; Variation of efficier ements; High efficiency cells, Types of Solar cells. CATION TECHNOLOGY electronic and solar grade Silicon; Production Z) method: Procedure of masking, photolithogra ar cell; High efficiency III-V, II-VI multi-junction s hermo-photovoltaics. TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detai <i>Aaximum tracking; Use of computers in array de</i> hoting.	r interface; The and illumination ncy with band-gap and 9 of single crystal Silicon: aphy and etching; Design of colar cell; a-Si-H based solar 9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
ircuit of the Solar Cell, Analysis of PV Cells: Dark of solar cell; Efficiency limits; Variation of efficient ements; High efficiency cells, Types of Solar cells. CATION TECHNOLOGY electronic and solar grade Silicon; Production Z) method: Procedure of masking, photolithogra ar cell; High efficiency III-V, II-VI multi-junction s lermo-photovoltaics. TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detai Maximum tracking; Use of computers in array de poting.	and illumination hey with band-gap and 9 1 of single crystal Silicon: aphy and etching; Design of colar cell; a-Si-H based solar 9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
control of solar cell; Efficiency limits; Variation of efficiency cells, Types of Solar cells. CATION TECHNOLOGY electronic and solar grade Silicon; Production Z) method: Procedure of masking, photolithogra ar cell; High efficiency III-V, II-VI multi-junction s hermo-photovoltaics. TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detail Aaximum tracking; Use of computers in array de- hoting.	9 of single crystal Silicon: aphy and etching; Design of colar cell; a-Si-H based solar 9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
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electronic and solar grade Silicon; Production Z) method: Procedure of masking, photolithogra ar cell; High efficiency III-V, II-VI multi-junction s lermo-photovoltaics. TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detai Maximum tracking; Use of computers in array de noting.	n of single crystal Silicon: aphy and etching; Design of solar cell; a-Si-H based solar 9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
TAIC SYSTEM DESIGN and performance prediction; Shadow analysis: esign; Design process and optimization; Detai Maximum tracking; Use of computers in array de poting.	9 Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
and performance prediction; Shadow analysis: esign; Design process and optimization; Detai Maximum tracking; Use of computers in array de poting.	Reliability; Solar cell array iled array design; Storage esign; Quick sizing method; 9 ted system, System
esign; Design process and optimization; Detai Aaximum tracking; Use of computers in array de poting.	iled array design; Storage esign; Quick sizing method; 9 ted system, System
Maximum tracking; Use of computers in array de poting.	esign; Quick sizing method; 9 ted system, System
poting.	9 ted system, System
;	9 ted system, System
	ted system, System
nts in Solar cells, Role of nano-technology in Sola ation, telecommunications, aerospace, agricultu , offshore, etc.	ar cell. Solar thermal Ire, fencing, water
	TOTAL: 45 PERIODS
Kishore, 'Renewable Energy Engineering and Te	echnology – A Knowledge',
ovotaics – Fundamentals', Technologies and A	Applications, PHI Learning,
	ey & Sons, 2007.
of Semiconductor Devices', 3 rd Edition, John Wile	m Applications', Prentice-
of Semiconductor Devices', 3 rd Edition, John Wile Operating Principles, Technology, and Syste	
of Semiconductor Devices', 3 rd Edition, John Wild Operating Principles, Technology, and Syste /ice Physics', Academic Press, 1982.	
	of Semiconductor Devices', 3 rd Edition, John Wiles Operating Principles, Technology, and Syste

COURS	SE CODE:	COURSE TITLE:	L	Т	Р	С
10212	2EE156	WIND ENERGY CONVERSION SYSTEMS	3	0	0	3
COURSE CAT	EGORY: Program	ime Elective				
PREAMBLE:	Wind energy is	the fast-growing renewable source for elect	ricity ge	neratio	n. This	course
presents a br	oad overview of	wind energy technology.				
PREREQUISIT	E COURSES: Bas	ic Electronics and Measurement Engineering				
COURSE EDU	CATIONAL OBJE	CTIVES:				
The objective	s of the course :	are to				
The objective		iie (0,				
 Know 	v about Power e	straction from wind energy				
• Unde	erstand the comp	oonents and design of wind tower				
• Unde	erstand working	principle of induction generator, synchronous ger	erator			
COURSE OUT	COMES:					
Upon the	e successful com	pletion of the course, students will be able to:				
CO Nos.		Course Outcomes	Know	vledge L n revised Taxon	.evel (B l Bloom omy)	ased I's
CO1	Explain the f measurement	undamentals of wind energy conversion and s.		K	2	
CO2	Summarize th	e types of wind turbines and aerodynamics.		K	2	
CO3	Explain the construction.	basic components of wind turbine and its		K	2	
CO4	Illustrate the p	oower management and grid monitoring unit.		K	2	
CO5	Explain the Op	eration & Maintenance for product lifecycle.		K	2	
<u></u>	1		1			

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н									L	L	Н	L
CO2	Н	Н									L	L	Н	L
CO3	Н	Н									L	L	Н	L
CO4	Н	Н									L	L	Н	L
CO5	Н	Н									L	L	Н	L

UNIT I WIND ENERGY FUNDAMENTALS AND MEASUREMENTS 9 Wind energy basics - Wind speed and scales - Terrain-Roughness-Wind mechanics - Power content – Class of wind turbine- Atmospheric boundary layers-Turbulence. Instrumentation for wind measurements - Wind data analysis - tabulation. Wind resource estimation - Betr's Limit-Turbulence analysis. UNIT II WIND TURBINE AREODYNAMICS AND TYPES 9 Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor & Blade)-Types of loads - Source of loads-Vertical axis type -Horizontal axis - Constant speed Constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator. 9 Electronics sensors / Encode / Resolvers - Wind measurement: anemometer & wind vane - Grid synchronisation system - Soft starter - Switchgear [ACB/VCB]-Transformer - Cables and assembly - Compensation panel - Programmable logic control - UPS - Yaw & pitch system: AC drives - Safety chain circuits - Generator rotor rotesistor controller(Flexi silp) - Different and protection relay for generator - Battery/Super capacitor charger & Batteries/Super capacitor for pitch system. Transient Suppressor/Lightning arrestors - Oscillation & Vibration sensing. 9 UNIT IV DIRECT ROTOR COUPLED GENERATOR 9 Excited rotor synch. Generator/PMG generator - Control Rectifier-Capacitor banks - Step up/Boost converter (DC-DC Step Up) - Grid ted inverter - Power management - Grid monitoring unit (Voltage and current) - Transformer - Safety chain circuits. 9 <	COURSE CONTEN	IT:										
Wind energy basics - Wind speed and scales - Terrain-Roughness-Wind mechanics - Power content – Class of wind turbine- Attractional Strumentation for wind measurements - Wind data analysis - tabulation. Wind resource estimation - Betz's Limit-Turbulence analysis. UNIT II WIND TURBINE ARECOPYNAMICS AND TYPES 9 Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor & Blade) - Types of loads - Source of loads-Vertical axis type - Horizontal axis - Constant speed constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator. UNIT III GEAR COUPLED GENERATOR WIND TURBINE generator - Cables and assembly - Compensation panel - Programmable logic control - UPS - Yaw & pitch system: AC drives - Safety chain circuits - Generator rotor resistor controller(Flexi Silp) - Differential protection relay for generator - Battery/Super capacitor charger & Batteries/Super capacitor for pitch system-Transient Suppressor/Lightning arrestors - Socillation & Vibration sensing. 9 UNIT IV DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE](VARIABLE SPEED - VARIABLE FREQUENCY 9 Excited rotor synch. Generator/PMG generator - Control Rectifier-Capacitor banks - Step up/Boost converter (DC-DC Step Up) - Grid tied inverter - Power management - Grid monitoring unit (Voltage and current) - Transformer - Safety chain circuits. 9 DINECT ROTOR COUPLED GENERATOR (NULTIPOLE](VARIABLE SPEED - VARIABLE FREQUENCY 9 Excited rotor synch. Generator/PMG generator - Control Rect	UNIT I	WIND ENERGY FUNDAMENTALS AND MEASUREMENTS	9									
UNIT IIWIND TURBINE AREODYNAMICS AND TYPES9Airfoil terminolog technique (Rotor & Blade element theory - Blade design - Rotor performation and sconstant speed constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled getter to type - Direct generator drive/PMG/Rotor excited syst type - Horizontal ands - Constant Speed Sinchroniable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gemerator type - Direct generator drive/PMG/Rotor excited syst Sill control - Pitch control - Gemerator - Baster - Switchgear (ACB/VCB)-Transformer - Cables and assembly - Compensation parel - Programmable logic control - UPS - Yaw & pitch system: AC drives - Safety chain circuits - Generator / Programmable logic control - UPS - Yaw & pitch system: AC drives - Safety chain circuits - Generator/PMG generator control Rectifier-Capacitor bit system: Suppressor/Lightning arrestors - Oscil tied inverter - Power management - Grid monitority unit (Voltage and current) - Transformer - Sid tied inverter - Power management - Grid monitority and generation reports - Operation System & Control Algorithms-Protections used & Safety control in and turbine-Wind turbine monitoring unit error codes - SCADA & Databases: remote monitoring and generation reports - Operation & Mainter of product lifecycle - Balancing technique (Rotor & Bade) - FACTS control & UNT V SYSTEMMONT IVMODERN WIND TURBINE CONTROL & MONITORING SYSTEM9Details of pitch	Wind energy bas wind turbine- A data analysis - ta	ics - Wind speed and scales - Terrain-Roughness-Wind mecha tmospheric boundary layers-Turbulence. Instrumentation for bulation. Wind resource estimation - Betz's Limit-Turbulence a	nics - Power content – Class of r wind measurements - Wind analysis.									
Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor & Blade)-Types of loads - Source of loads-Vertical axis type - Horizontal axis - Constant speed Constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator. UNIT III GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION 9 Electronics sensors /Encode /Resolvers - Wind measurement: anemometer & wind vane - Grid synchronisation system - Soft starter - Switchgear [ACB/VCB]-Transformer - Cables and assembly - Compensation synch or Soft starter - Switchgear [ACB/VCB]-Transformer - Cables and assembly - Gomerator rotor resistor controller(Flexi slip) - Differential protection relay for generator - Battery/Super capacitor for pitch system: AC drives - Safety chain circuits - Generator/PMG generator - Control Rectifier-Capacitor banks - Step up/Boost converter (DC-DC Step Up) - Grid tied inverter - Power management - Grid monitoring unit (Voltage and current) - Transformer - Safety chain circuits. 9 UNIT V MODERN WIND TURBINE CONTROL & MONITORING SYSTEM 9 Details of pitch system & Control Algorithms-Protection sued & Safety consideration in wind turbine-Wind turbine monitoring with error codes - SCADA & Databases: remote monitoring and generation reports - Operation & Maint=nance for product lifecycle - Balancing technique (Rotor & Blade) - FACTS control & LVRT & New trends for mediating technique (Rotor & Blade) - FACTS control & LVRT & New trends for monitoring and generation reports - Operation & Maint=nance for product lifecycle - Balancing technique (Rotor & Blade) - FACTS control & LVRT & New trends for monitorin	UNIT II	WIND TURBINE AREODYNAMICS AND TYPES	9									
UNIT III GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION 9 Electronics sensors / Encode / Resolvers - Wind measurement: anemomet & wind vane - Grid synchronisation panel - Programmable logic control – UPS - Yaw & pitch system: - Cables and assembly - Compensation panel - Programmable logic control – UPS - Yaw & pitch system: AC drives - Safety chain circuits - Generator rotor resistor controller(Flexi slip) - Differential protection relay for generator - Battery/Super capacitor charger & Batteries/Super capacitor for pitch system:	Airfoil terminology - Blade element theory - Blade design - Rotor performance and dynamics- Balancing technique (Rotor &Blade)-Types of loads - Source of loads-Vertical axis type -Horizontal axis - Constant speed Constant frequency - Variable speed variable frequency - Up wind-Down wind - Stall control-Pitch control - Gear coupled generator type - Direct generator drive/PMG/Rotor excited sync generator.											
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COURSE CODE:	COURSE TITLE:	L	Т	Ρ	С
10212EE157	GENERATION PLANNING	3	0	0	3

PREAMBLE: It is aimed to provide the basics of power system planning, particularly on generation capacity expansion planning and provide the information about the impact of environmental pollution, reliability on integration of demand and supply side management activities in addition renewable energy sources penetration.

PREREQUISITE COURSES: Power System Operation and Control

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the load forecasting techniques, power generation reliability indices
- Know the basic concepts of generation expansion planning and WASP-IV module
- Compare the demand side and supply side management in GEP studies and the effect of penetration of renewable energy resources in power system

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Interpret the load forecasting techniques	К2
CO2	Explain types of reliability indices for power generation system	К2
CO3	Illustrate the basic concept of GEP problem	К2
CO4	Solve the effect of DSM and SSM activities in GEP	КЗ
CO5	Identify the impact of renewable energy on environmental pollution and reliability of power system	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М		L								L	Н	L
CO2	Н	Н		М									Н	L
CO3	Н	L		L	М						L	L	Н	L
CO4	Н	L	Μ	М	М						L		Н	L
CO5	н	L	М	М	М		М				L	L	Н	L

COURSE CO	NTENT:	
UNIT I	LOAD FORECASTING	9
Power syste	em planning- Objective- Stages in planning and design - need for accurate load	forecasting
- factors a	ffecting forecasting- approaches- methodology- Short-run and long run-	Time series
techniques	Peak demand and Energy forecasting	
UNIT II	POWER GENERATION RELIABILITY	9
Static Gene	rating Capacity Reliability Evaluation- Outage definitions-reliability indices-	loss of load
probability	(LOLP) - expected energy not served (EENS) - capacity outage probability tak	ole (COPT) -
simple prob	olems.	
UNIT III	GENERATION COST OPTIMIZATION	9
Definition-F	formulation of least cost optimization problem- capital, operation and mainte	nance costs
- candidate	units - different types- Wien Automatic System Planning- IV (WASP-IV) mode	el- WASP-IV
modules-si	nple simulation studies	
	DEMAND SIDE MANAGEMENT (DSM) AND SUPPLY SIDE MANAGEMENT	٩
	(SSM)	5
implementi SSM –Intro SSM in gen	ng DSM programmes duction-options and opportunities - constraints and challenges - integration operation planning	of DSM and
UNIT V	GENERATION PLANNING WITH RENEWABLE ENERGY	9
Benefits of negative loa	renewable energy sources- Modelling of wind and solar plants in planni ad modelling- environmental analysis and reliability analysis.	ing studies-
	TOTAL: 4	45 PERIODS
ТЕХТВООК	5:	
1. Sul	ivan, R. L. 'Power System Planning', McGraw-Hill New York, 1977	
2. Jan	nes McDonald, Wang Xifan, 'Modern Power System Planning', McGraw-Hill, 19	94.
REFERENCE	BOOKS:	
1. Roy	Billinton and Ronald N. Allan, 'Reliability Evaluation of Engineering	g Systems:
Cor 2. Roy Sys Spr	ncepts and Techniques', Springer science-Business Media, 1992. Billinton and Rajesh Karki, 'Reliability and Risk Evaluation of Wind Integrates tems' (Reliable and Sustainable Electric Power and Energy Systems Ma inger, 2013.	ated Power nagement),
3. Seit Alg	i, Hossein, Sepasian, Mohammad Sadegh, 'Electric Power System Plan prithms and Solutions', Springer, 2011.	ning-Issues,
4. Leo	n K. Kirchmeyer, 'Economic Operation of Power System', Wiley, 2009.	

COURSE CODE: COURSE TITLE:	L	Т	Р	С
10212EE158 SOLAR PHOTOVOLTAIC SYSTEMS	3	0	0	3

PREAMBLE: This course emphasizes the growing demand of renewable energy sources especially harnessing power from sun. Solar Photo Voltaic technology and systems comprise of the fundamentals, design, optimization and application of solar photovoltaic systems for power generation on small- and large-scale electrification.

PRE-REQUISITES: Basic Electronics and Measurement Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Familiar with basics of solar PV
- Familiar with various PV performance measure terminologies.
- Understand about manufacturing of PV cells & sizing aspects of PV systems.
- Understand about PV system components and apply them in installation practices & associated trouble shootings.
- Understand about PV system applications and associated safety measures.

COURSE OUTCOMES:

Upon the completion of the course students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the principle of direct solar energy conversion to power using PV	К2
CO2	Contrast the performance measures of PV	К2
CO3	Infer on solar cells & design aspects of solar PV	К2
CO4	Identify PV components and installation practices	К2
CO5	Develop ideas for working on solar PV systems and associated safety practices	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	L					Н							L
CO2	н	М					L					Н		
CO3	Н	М			Н		L					Н		Н
CO4	Н	Н					L							Н
CO5	Н	Н	Н		Н	Н	Н		Н		Н		М	Н
UNIT I SOLAR CELL FUNDAMENTALS 9 Principle of solar energy conversion, Photovoltaic effect, Semiconductor properties, energy levels, basic equations. Solar cell structure, parameters of solar cell. UNIT II PV MODULE PERFORMANCE 9 Solar PV modules & arrays, I-V & P-V characteristics, maximum power point, series parallel combination, cell efficiency, fill factor, role of bypass & blocking diode, factors affecting output of a solar cell. 9 UNIT III MANUFACTURING OF PV CELLS & DESIGN OF PV 9 Systems Systems 9 Commercial solar cells - Production process of single crystalline silicon cells, multi crystalline silicon cells, amorphous silicon, cadmium telluride, copper indium gallium diselenide cells. Design of solar PV systems, cost estimation, various aspects, system simulation tools. 9 UNIT IV SOLAR PV SYSTEMS INSTALLATIONS & TROUBLE 9 Classification - Central Power Station System, Distributed PV System, Standalone PV system, grid Interactive PV System, small system for consumer applications, hybrid solar PV system, grid Interactive PV System, small system components - PV array, inverters, batteries, charge controllers, net metering. PV array installation, operation, costs, reliability. Troubleshooting of PV system components. 9 UNIT V PV SYSTEM APPLICATIONS & SAFETY 9 Building-integrated photovoltaic units, grid connected central power stations, stand-alone devices for distributed power supp	COURSE CONTENTS													
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UNIT III MANUFACTURING OF PV CELLS & DESIGN OF PV SYSTEMS 9 Commercial solar cells - Production process of single crystalline silicon cells, multi crystalline silicon cells, amorphous silicon, cadmium telluride, copper indium gallium diselenide cells. Design of solar PV systems, cost estimation, various aspects, system simulation tools. 9 UNIT IV SOLAR PV SYSTEMS INSTALLATIONS & TROUBLE SHOOTING 9 Classification - Central Power Station System, Distributed PV System, Standalone PV system, grid Interactive PV System, small system for consumer applications, hybrid solar PV system, concentrator solar photovoltaic. System components - PV arrays, inverters, batteries, charge controllers, net metering. PV array installation, operation, costs, reliability. Troubleshooting of PV system components. 9 UNIT V PV SYSTEM APPLICATIONS & SAFETY 9 Building-integrated photovoltaic units, grid connected central power stations, stand-alone devices for distributed power supply in remote and rural areas, Outlook for the Indian PV industry& challenges, Applications: solar home system, solar cars, Solar Charger, aircraft, space solar power satellites. Socio-economic and environmental merits of photovoltaic systems safety in Installation of solar PV systems TEXTBOOKS: 1. Chetan Singh Solanki, 'Solar Photovoltaic: Fundamentals, Technologies and Application', PHI Learning Pvt., Ltd., 2009. 2. 1. Chetan Singh Solanki 'Solar PV Technology and System', PHI Learning Private Limited, 2015. 2. 2. Partain	Solar PV modules combination, cell effici solar cell.	& arrays, I-V &P-V characteristics, maximum power ency, fill factor, role of bypass & blocking diode, factor	point, series parallel rs affecting output of a											
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UNIT IVSOLAR PV SYSTEMS INSTALLATIONS & TROUBLE SHOOTING9Classification - Central rower Station System, Distributed PV System, Standalower VV system, grid Interactive PV Systew, small system for consumer applications, hybrid solar PV system, concentrator solar pbotovoltaic. System components - PV arrays, inverters, batteries, charge controllers, net metering. PV array installation, operation, costs, reliability. Troubleshooting of PV system components.UNIT VPV SYSTEM APPLICATIONS & SAFETY9Building-integrated pbotovoltaic units, grid connected central power stations, stand-alone devices for distributed power supply in remote and rural areas, Outlook for the Indian PV industry& challenges, Applications: solar home system, solar cars, Solar Charger, aircraft, space solar power satellites. Socio-econeous and environmental merits of photovoltaic systems supply in Installation of solar PV systemsTOTAL: 45 PERIODSTEXTBOOKS:1.Chetan Singh Solanki, 'Solar Photovoltaic: Fundamentals, Technologies and Application', PHI Learning Pvt., Ltd., 2009.2.Jha A.R., 'Solar Cell Technology and Applications', CRC Press, 2010.2.Partain L.D., Frass L.M., 'Solar PV Technology and System', PHI Learning Private Limited, 2015.2.Partain L.D., Frass L.M., 'Solar Cells and Their Applications', 2 nd Edition, Wiley, 2010.3.S.P. Sukhatme, J.K.Nayak., 'Solar Energy', Tata McGraw Hill Educatior Private Limited, New Delhi, 2010.4.R.K Pachauri 'From Sun light to Electricity' TERI, 15 th Reprint, 2013	Commercial solar cells cells, amorphous silico PV systems, cost estim	 Production process of single crystalline silicon cells, m n, cadmium telluride, copper indium gallium diselenide ation, various aspects, system simulation tools. 	ulti crystalline silicon cells. Design of solar											
Classification - Central Power Station System, Distributed PV System, Standalone PV system, grid Interactive PV System, small system for consumer applications, hybrid solar PV system, concentrator solar photovoltaic. System components - PV arrays, inverters, batteries, charge controllers, net metering. PV array installation, operation, costs, reliability. Troubleshooting of PV system components. UNIT V PV SYSTEM APPLICATIONS & SAFETY 9 Building-integrated photovoltaic units, grid connected central power stations, stand-alone devices for distributed power supply in remote and rural areas, Outlook for the Indian PV industry& challenges, Applications: solar home system, solar cars, Solar Charger, aircraft, space solar power satellites. Socio-economic and environmental merits of photovoltaic systems safety in Installation of solar PV systems TOTAL: 45 PERIODS TEXTBOOKS: 1. Chetan Singh Solanki., 'Solar Photovoltaic: Fundamentals, Technologies and Application', PHI Learning Pvt., Ltd., 2009. 2. Jha A.R., 'Solar Cell Technology and Applications', CRC Press, 2010. REFERENCE BOOKS: 1. Chetan Singh Solanki 'Solar PV Technology and System', PHI Learning Private Limited, 2015. 2. Partain L.D., Fraas L.M., 'Solar Cells and Their Applications', 2 nd Edition, Wiley, 2010. 3. S.P. Sukhatme, J.K.Nayak., 'Solar Energy', Tata McGraw Hill Education Private Limited, New Delhi, 2010. 4. R.K Pachauri 'From Sun light to Electricity' TERI, 15 th Reprint, 2013	UNIT IV	SOLAR PV SYSTEMS INSTALLATIONS & TROUBLE SHOOTING	9											
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TOTAL: 45 PERIODS TEXTBOOKS: 1. Chetan Singh Solanki., 'Solar Photovoltaic: Fundamentals, Technologies and Application', PHI Learning Pvt., Ltd., 2009. 2. Jha A.R., 'Solar Cell Technology and Applications', CRC Press, 2010. REFERENCE BOOKS: 1. Chetan Singh Solanki 'Solar PV Technology and System', PHI Learning Private Limited, 2015. 2. Partain L.D., Fraas L.M., 'Solar Cells and Their Applications', 2 nd Edition, Wiley, 2010. 3. S.P. Sukhatme, J.K.Nayak., 'Solar Energy', Tata McGraw Hill Education Private Limited, New Delhi, 2010. 4. R.K Pachauri 'From Sun light to Electricity' TERI, 15 th Reprint, 2013	Building-integrated ph for distributed power challenges, Application satellites. Socio-econo solar PV systems	otovoltaic units, grid connected central power stations supply in remote and rural areas, Outlook for the ns: solar home system, solar cars, Solar Charger, aircra mic and environmental merits of photovoltaic systems s	s, stand-alone devices Indian PV industry& aft, space solar power afety in Installation of											
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	4. R.K Pachauri 'F	rom Sun light to Electricity' TERI, 15 th Reprint, 2013												

cou	IRSE	E CODE: COURSE TITLE: L T P C														
102	2128	EE1	59			I		ELECTR	ONICS			_	3	0	0	3
COUR	RSE (САТ	EGOR	Y: Prog	ramme	Electiv	'e					I		1		
PREAMBLE: The purpose of the course is to provide students with the basic knowledge in nano																
electronics. This course emphasize on nano materials, types, synthesis, interconnects and fabrication.																
PRER	PREREQUISITE COURSES: Engineering Physics															
COURSE EDUCATIONAL OBJECTIVES:																
The o	The objectives of the course are to,															
•	K n	nov anc	w the tr mate	ypes of rials.	nanot	echnolo	ogy, ato	omic st	ructure	e, molec	ular tec	hnold	ogy a	and pre	eparatio	on of
•	U	nde	erstand	d the fu	Indame	entals o	f nano	electro	onics ar	nd its pr	operties	5.				
•	K	nov	w the S	ilicon N	NOSFE	ſ's, QTI) and c	arbon ı	nano tu	ıbes.						
•	U	nde	erstand	d the fu	Indame	entals o	of mole	cular el	ectron	ics						
COUR	RSE (יטכ	ГСОМЕ	S:												
Upon	the	suc	ccessfu	I comp	letion	of the c	ourse,	studen	its will	be able	to:					
CO					Co	ourse C	outcom	es			K	nowle	edge I Blo	e Level	(Based	d on mv)
1405	•	D :										VISCO				
CO1	L	an	d the p	ne type prepara	es of ha	notecr nano r	nology nateria	ls.	cular te	cnnolo	gy			К2		
CO2	2	Ex de	plains vices, f	the fu field eff	undame fect dev	ental o vices, a	f the nd spir	device tronics	s such	as log	gic			K2		
CO3	3	De Tra	escribe anspor	the co t Devic	oncept: es.	s of si	licon N	NOSFE	Г and	Quantu	m			K2		
CO4	Ļ	Su ap	mmari plicatio	ze the	e type carbon	es, sy nano ti	nthesis ubes.	s, inte	erconne	ects ai	nd			K2		
CO5	5	Ex ap	plain plicatio	the ons of r	concep nolecu	ots, fi lar elec	unctior tronics	ns, fa	bricatio	ons ai	nd			K2		
CORR	ELA	TIC	N OF C	COs WI	TH POs	AND F	SOs									
COs	PC)1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO1	1	PO12	PSO1	PSO2
CO1	ŀ	1	L											L	М	
CO2	ŀ	1	L											L	М	
CO3	ŀ	4	L	L								L		L	М	L
CO4	ŀ	н L											L	М		
CO5	CO5 H L L										L					
COURSE CONTENT:																
	UNI	ТΙ		INTRO	DUCTI	ON TO	NANO	TECHN	OLOG	(9	
Introd in ele	duct ctro	ion nic:	: Discu s from	ission o microe	of Inter	nationa nics tow	al Tech /ards b	nology iomole	Roadn cule ele	nap cha ectronic	racterist s.	tics: N	leed	d for n	ew con	cepts

Background to nanotechnology: Types of nanotechnology and nanomachines – periodic table – atomic structure – molecules and phases – energy – molecular and atomic size – surface and dimensional space – top down and bottom up.

Molecular Nanotechnology: Electron Microscope – Scanning Electron Microscope – Atomic Force Microscope – Scanning Tunneling Microscope.

Nanomaterials: Preparation –Plasma Arcing – Chemical Vapor Deposition – Sol-Gels – Electrode Position – Ball Milling –Applications Of Nanomaterials.

UNIT II	FUNDAMENTALS OF NANO ELECTRONICS	9
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Fundamentals of logic devices: requirements – dynamic properties – threshold gates; physical limits to computations; concepts of logic devices: classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics – quantum cellular automata – quantum computing – DNA computer; performance of information processing systems;- basic binary operations, measure of performance processing capability of biological neurons – performance estimation for the human brain. Ultimate computation: power dissipation limit – dissipation in reversible computation – the ultimate computer.

UNIT III	SILICON MOSFETS & QUANTUM TRANSPORT DEVICES	9
-		-

Silicon MOSFETS - Novel materials and alternate concepts: fundamentals of MOSFET Devices- scaling rules – silicon-dioxide based gate dielectrics – metal gates – junctions & contacts – advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: Electron tunneling – resonant tunneling diodes – resonant tunneling devices; Single electron devices for logic applicationsSingle electron devices – applications of single electron devices to logic circuits.

UNIT IV	CARBON NANOTUBES	
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Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies - purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs – nanotube for memory applications – prospects of all carbon nanotube nanoelectronics.

UNIT V	MOLECULAR ELECTRONICS	9
		5

Electrodes & contacts – functions – molecular electronic devices – first test systems – simulation and circuit design – fabrication; Future applications: MEMS – robots – random access memory – mass storage devices.

TOTAL: 45 PERIODS

9

TEXT BOOKS:

- 1. Michael Wilson, KamaliKannangara, Geoff Smith, Michelle Simmons and Burkhard
- 2. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.

REFERENCE BOOKS:

- 1. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.
- 2. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, TMH, 2007.M.Ziese and M.J Thornton (Eds.)"Spin Electronics ", Springer-verlag 2001.
- 3. M.Dutta and M.A Stroscio Edited by "Quantum Based Electronic Devices and systems", world Scientific, 2000.

ONLINE RESOURCES:

1. https://www.edx.org/course/fundamentals-nanoelectronics-part-b-purduex-nano521x

со	JRSE	RSE CODE: COURSE TITLE:										L	Т	Р	С
10)212E	212EE160 GREEN ELECTRONICS									3	0	0	3	
COUF	COURSE CATEGORY: Programme Elective														
PREA meth produ envir	PREAMBLE: This course aims to provide students with knowledge on the theories, eco-design concepts, methods, and relevant hands-on experience for designing a range of sustainable green electronic products. It is expected that students will develop their ability to address relevant issues on environmental impact; product design, operating life, and the 3R concept (reduce, reuse, and recycle)														
PRER	PREREQUISITE COURSES: Environment Engineering														
COUF	COURSE EDUCATIONAL OBJECTIVES:														
The o	bject	ives of th	ne cour	se are t	to,										
•	Stu	udy the i	ntrodu	ction of	fgreen	electro	onics								
•	Stu	udy the g	reen el	lectron	ics mat	erials a	and pro	ducts							
•	Stu	udy the g	reen el	lectron	ics asse	embly a	and rec	ycling							
•	Stu	udy the f	lip-chip	assem	ibly and	d bondi	ing for	lead-fre	ee elec	tronics					
COUF	RSE O	итсомі	ES:												
Upon	the s	successfu	ıl comp	letion	of the c	ourse,	studen	ıts will	be able	e to:					
CO Nos.				(Course	Outcor	nes				Knowledge Level (Based on revised Bloom's Taxonomy)				
CO1	R g m	ecognise reener nanufacti	and a world, uring in	ddress and the lo	the is enviror cal indu	sues r imenta istry	elating I elec	to the tronic	e need desigr	for a n and	К2				
CO2	R ir fo	ecognise indiffer or compli	the im ent ma ance w	iportan ajor coi vith the	ice of v untries se regu	arious aroun Ilations	enviro d the v	nmenta vorld a	al regul Ind the	ations need			К2		
CO3	A Se	pply the elected c	e princ onsum	ciples er proc	and pr lucts	actices	of gr	een e	lectron	ics in			К2		
CO4	D e	escribe nvironm	the pr ental ha	ocess azards	and te and su	chniqu ggest w	es of vays to	assessi reduce	ment o them.	of the			К2		
CO5	Realize the impact of the environmental regulations on the design, supply chain, manufacturing and recycling of the electronic products.K2														
CORRELATION OF COS WITH POS AND PSOS															
COs	Os PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO1									PO10	PO11	РО	12	PSO1	PSO2
CO1	1 H L											L	М		
CO2	H L										L	М			
CO3	Н	L	L								L	I	L	М	L
CO4	Н	L												М	
CO5	Н	L	L								L	I		М	L

COURSE CONTENT:										
UNIT I	UNIT I INTRODUCTION OF GREEN ELECTRONICS 9									
Environmental co regulations in Ch (RoHs) – Waste Registration Evalu	Environmental concerns of the modern society – Overview of electronics industry and their relevant regulations in China, European Union and other key countries. Restriction of Hazardous substances (RoHs) – Waste Electrical and electronic equipment (WEEE) – Energy using Product (EUP) and Registration Evaluation, Authorization and Restriction of Chemical substances (REACH).									
UNIT II	GREEN ELECTRONICS MATERIALS AND PRODUCTS	9								
Introduction to g adhesives, halog polymer based co substances in ele Influence Whiske Tin Whisker Risk	reen electronic materials and products – Lead (Pb) – free sold en-free substrates and components. Substitution of non-recy omposites with recyclable materials X-Ray Fluorescence (XRF) for ectronic products. Tin Whiskers Growth in Lead-Free Electronic r Growth – Ways to Mitigate Tin Whisker Risk – Use Finite Elemen – Evaluation of Tin Whisker Impact on High-Reliability Application	er pastes, conductive clable thermosetting identifying hazardous Assemblies – Factors nt Modeling to Assess s.								
UNIT III	GREEN ELECTRONICS ASSEMBLY AND RECYCLING	9								
Green electronic Deterioration of Solders – Therm Prediction Based Assembly proces system construct	c Assembly – Soldering Process – Lead-Free Solder Tip and Lead-Free Tin Solder at Low Temperatures – Fatigue Character al Fatigue of Solder Joints, Fatigue Design of Lead-Free – Elect on Field Profile, Fatigue Validation of Lead-Free Circuit – Flip- s – card Assembly, surface mount technology – Management ion, global collaboration and product disassemble technology.	Bumps – Mitigate erization of LeadFree tronics – Fatigue Life Chip Technology and t on e-waste recycle								
UNIT IV	FLIP-CHIP ASSEMBLY AND BONDING FOR LEAD-FREE ELECTRONICS	9								
Flip-Chip Assemb Bonding – Mater Reflow soldering Failure Calculation Integrated Circu Integration.	oly Process – Placement and Under fill stage-FEM of Die stres rials and Process Variations – Integrating Flip Chip into a Star Techniques and Analytical Methods – Electro migration Analy ons – Gold-Tin Solder Integrating Vertical-Cavity Surface E its – Design and Processing of Flip-Chip Bonding Structur	s – Gold stud Bump ndard SMT Lead-Free sis for Mean-Time-to mitting Lasers onto es – OptoElectronic								
UNIT V	REAL TIME GREEN ELECTRONIC	9								
Lead-Free Electronic Design – Selection of the Package Type – Substrate or Die Attachment FR4 – Electrical Connections from Die to FR4 – Assess Impact of CTE Mismatch on Stress and Fatigue Life – Design Solder Balls for External Connection to PCB – Thermal Analysis of Flip-Chip Packaging – RLC for Flip-Chip Packages – Drop Test of Flip-Chip Packaging – Wei bull Distribution for Life Testing and Analysis of Test Data.										
TOTAL: 45 PERIODS										
 John X.Wang 'Green Electronics Manufacturing', CRC Press Indian Prentice Hall, 2012 Sammy G Shina, 'Green Electronics Design and Manufacturing' Mc Graw Hill 2008. 										
REFERENCE BOOKS: 1 Lee Goldberg "Green Electronics/Green Bottom Line Newnes Publications 2000										
ONLINE RESOUR	CES:									
1. <u>www.npt</u>	el.com									

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10212EE161	AUTOMOTIVE ELECTRONICS	3	0	0	3

COURSE CATEGORY: Programme Elective

PREAMBLE: This subject serves as the prerequisite for many subjects such as basic electrical & electronics engineering, microprocessor & micro controller. It introduces students to cognitive learning in applied electrical & electronics and develops problem solving skills with both theoretical and engineering oriented problems.

PREREQUISITE COURSES: Basic Electronics Engineering and Microprocessor and Microcontrollers

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Learn concepts and develop basic skills necessary to diagnose automotive electrical problems
- Understand starting and charging, lighting systems, advanced automotive electrical systems, to include body electrical accessories, and basic computer control.
- Understand the instructions necessary to take the Automotive Service Excellence examination.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basic automotive and transmission systems.	К2
CO2	Explain the various functions of the sensors and actuators in the field of automotive applications	К2
CO3	Discuss about the various analog and digital control methods.	К2
CO4	Describe the Electronic control unit design.	К2
CO5	Explain the various interfacing techniques and applications of automotive electronics.	К2

-	1													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М	М								М	М	Н	
CO2	Н	М	М								М	М	Н	L
CO3	Н	М	М								L	L	Н	L
CO4	Н	М	М									L	Н	L
CO5	Н	М	М									L	Н	L

COURSE CONTENT:									
UNIT I	FUNDAMENTAL OF AUTOMOTIVE ELECTRONICS	9							
Current trends i suppression, ele system, security a	Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.								
UNIT II SENSOR TECHNOLOGIES IN AUTOMOTIVE 9									
Interfacing princi vehicle processir Instrumentation reduction. ADCs use within the au	ples: Operation, topologies and limitations of all sensors cove ng or communications nodes. Interfacing electronics, Operati amplifiers, Comparators. Level shifting, Wave-shaping, Filters. and DACs. Use of Actuators: Types, Working principle, Charact tomotive context of each type	red in the above to in- ional amplifier circuits, Noise mechanisms and eristics, limitations and							
UNIT III	AUTOMOTIVE CONTROL SYSTEMS	9							
Control system a control augment traction control, Vehicle braking f for Lighting, Wipe	Control system approach in Automotive: Analog and Digital control methods, stability Augmentation, control augmentation, Transmission control, System components and Functions. Cruise control, traction control, actuator limiting, wind-up, gain scheduling, Adaptive control. Special Control Schemes: Vehicle braking fundamentals, Antilock Systems, Variable assist steering and steering control, Controls for Lighting. Wipers. Air conditions.								
UNIT IV	ELECTRONIC CONTROL UNIT DESIGN	9							
Critical review of of development emphasis on Por Usage. High-leve	microprocessor, microcontroller and digital signal processor E within the automotive context). Architecture of 8/16 bit ts, Timer/Counters, Interrupts, Watch-dog Timers, PWM, Me I language programming.	Development (overview microcontrollers with mory requirement and							
UNIT V	AUTOMOTIVE COMMUNICATION SYSTEMS	9							
Communication infotainment gao Wireless LANs st applications.	interface with ECUs: Interfacing techniques and interface dgets. Relevance of internet protocols, such as TCP/IP for au andards, such as Bluetooth, IEEE802.11x. Communication pro	ing with VTU R-2015 atomotive applications. otocols for automotive							
		TOTAL: 45 PERIODS							
TEXT BOOKS:									
 Williams. Science, Robert B 	B.Ribbens, 'Understanding Automotive Electronics', 6 th E Newness Publication. osch, Automotive Electronics Handbook', John Wiley and Sons,	Edition, 2003, Elsevier 2004.							
REFERENCE BOOKS:									
 James D Halderman, _'Automotive Electricity and Electronics', PHI Publication 2005. Terence Rybak, Mark Steffka, 'Automotive Electromagnetic Compatibility (EMC)', Springer, 2004. Allan Bonnick, 'Automotive Computer Controlled Systems: Diagnostic Tools and Techniques', Elsevier Science, 2001. BehzadRazavi, 'Design of Analog CMOS Integrated Circuits' McGraw-Hill, 1999. 									
ONLINE RESOUR	CES:								
1. <u>www.faa</u>	dooengineers.com								
2. <u>www.nptelvideos.in</u>									

COURS	SE CODE:	COURSE TITLE:		L	Т	Р	С					
1021	2EE162	VEHICLE ELECTRONICS		2	0	2	3					
COURSE	CATEGORY	: Programme Elective				1	1					
PREAMBLE: In this course, the students will learn about basic electronic modules used in modern vehicles and the networking architecture used to interconnect these modules.												
PREREQUISITE COURSES: Nil												
RELATE	RELATED COURSES: Nil											
COURSE	COURSE EDUCATIONAL OBJECTIVES:											
The obje	 The objectives of the course are to, Understand the working of basic electronic circuits Know the specifications and applications of different sensors, actuators and switching devices Understand high level programming languages Design and implement numerous automotive electronic systems 											
Upon th	e successfu	completion of the course, students will be able t	o:									
CO Nos.	CO Nos. Course Outcomes (Based on Dave's Taxonomy)											
CO1	O1 Interface various automotive sensors and actuators with given Microcontrollers S4											
CO2	Design ar engine pe	automotive electronic system for monitoring rformance, infotainment and telematics.			S4							
CO3	Recognize the appropriate protocols used in vehicle S2											

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	М	Н		Н				М			М	Н	Н
CO2	L	М	Н		Н				М			М	Н	Н
CO3	L	М	Н		Н				М			М	Н	Н
CO1 CO2 CO3	L L L	M M M	H H H		H H H				M M M			M M M	H H H	

COURSE CONTENT: THEORY

Introduction to basic electronics – Passive elements, Op-Amp, types of LED and LCD, logic gates, Mux, De-mux, driver circuits, ADC, DAC.

Sensors – Specifications and applications of ABS Sensor, wheel speed sensor, crank shaft position sensor, oxygen sensor, air flow sensor, tyre pressure sensor, engine coolant sensor, temperature sensor, brake fluid sensor, accelerometer, light sensor, Infra-Red, ultrasonic sensor.

Actuators – Specifications and applications of tyre inflator, AC unit compressor, windshield wiper, heating coil, lighting systems, airbag system, motors, valve.

Switching Devices – Specifications and applications of relays and switches – dip switch, push buttons, touch switch, toggle switch.

Automotive Electronic Systems – Antilock Braking System, Automatic Emergency Braking System, Engine Control System, Ignition Control and Start-Stop System, Heating and AC System, Vehicle Theft Security

System, Seat belt indication system, Camera and Ultrasonic sensor based Parking Assistance System, Vehicle navigation system, Vehicle telematics system.

High Level Programming – Features of Arduino and Raspberry Pi Boards, Basics of Embedded C and Python programming, programming using IDE – Arduino, MATLAB.

Networking – OSI layers, Bus architecture, LAN/WAN, CAN Protocol, FlexRay Protocol, Ethernet Protocol, AUTOSAR architecture

TOTAL: 30 HOURS

LIST OF EXPERIMENTS (15 HOURS)

- 1. LED and Push button interface using Arduino
- 2. LCD and Push button interface using Raspberry Pi
- 3. Design of turn light indicator system
- 4. Design of speed indication system
- 5. Design of image acquisition system
- 6. Design of stepper motor, servo motor and DC motor control

TEXTBOOKS:

1. Bosch Automotive Electrics and Automotive Electronics: Systems, Components and Hybrid Drive, Robert Bosch GmbH, Springer Vieweg, 2007.

				-	_	~					
COURS	E CODE:	COURSE TITLE:			Р	Ĺ					
10212	2EE163	OPTO ELECTRONIC DEVICES	3	0	0	3					
COURSE CATEGORY: Programme Elective											
PREAMBLE: Optoelectronic devices provide to learn different types of optical emission, detection and optoelectronic integrated circuits and their applications.											
PREREQU	JISITE COU	RSES: Nil									
RELATED	RELATED COURSES: Nil										
COURSE	COURSE EDUCATIONAL OBJECTIVES:										
The obje	ctives of the	e course are to,									
• l	Jnderstand	the fundamentals of optoelectronics									
• *	Know differ	ent types of display devices and laser technology									
• •	(now about	the importance of photo detectors in communication syst	em								
• l	Jnderstand	functioning of various modulation circuits and switching d	evices								
• 9	Study different optoelectronic integrated circuits and their applications.										
COURSE OUTCOMES:											
Upon the successful completion of the course, students will be able to:											
CO		Course Outcomes Knowledge	Level (Based	on rev	vised					

Nos.	Course Outcomes	Bloom's Taxonomy)
CO1	Describe the fundamentals of optoelectronics	К2
CO2	Discuss the different types of display devices and operating principle of laser	К2
CO3	Classify the different types of photo detectors	К2
CO4	Explain about the modulators and switching devices	К2
CO5	Explain the integration methods, materials, OEIC transmitters receivers, guided wave devices and photonic integrated circuits	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	Ι			L							L		
CO2	L	М	М	L	М							М	L	
CO3	М	М	L	М										
CO4	L	L	М	М								М		
CO5	М	М	L	L	М				М		М	М		

COURSE CONTENT:										
UNIT I	FUNDAMENTALS OF OPTOELECTRONICS	9								
Nature of Lig Blackbody Rac Quantum Mec Devices	pht, Wave Nature of Light: Polarization – Interference - Diff diation, Units of Light, Generation of Photo electronics, Elements chanical Concept, Energy Bands in Solids, Semiconductors and S	raction, Light Sources: of Solid State Physics - emiconductor Junction								
UNIT II	DISPLAY DEVICES AND LASER	9								
Luminescence, Photoluminescence Cathode luminescence, Cathode Ray Tube, Electro Luminescence, Injection Luminescence, LED: Materials - Commercial LED Materials – Construction - Drive circuitry, Plasma Display, Liquid Crystal Displays, Numeric Displays, Emission and Absorption of Radiation, Population Inversion, Laser losses, Laser Modes: Mode Locking- Active Mode Locking - Passive Mode Locking, Laser Applications										
UNIT III PHOTO DETECTORS 9										
Thermal Detectors - Thermoelectric Detectors - Bolometer - Pneumatic Detectors – Pyro electric Detectors, Photon Devices - Photo Emissive Devices - Vacuum Photodiodes - Photo Multipliers- Photon Counting Techniques - Photo Conductive Detectors, Detector Performance Parameters.										
UNIT IV	UNIT IV MODULATION AND SWITCHING DEVICES 9									
Analog and D Absorption M Modulators - N	Analog and Digital Modulation, Franz- Keldysh and Stark Effect Modulators, Quantum well Electro Absorption Modulators, Electro-Optic Modulators- Birefringence and Electro-Optic Effect - Kerr Modulators - Magneto Optic Modulators, Optical switching, and logic devices.									
UNIT V	PHOTONICS & OPTOELECTRONIC INTEGRATED CIRCUITS	9								
Hybrid and M Processing for Receiver - OE Developments	onolithic Integration, Applications of Optoelectronic Integrated OEICs, Integrated Transmitters and Receivers- Front End Photo Re IC Transmitter, Guided Wave Devices. Photonics, Photonic Inte is in Photonic Integrated Circuits.	Circuits, Materials and eceiver - PIN HBT Photo grated Circuits, Recent								
		TOTAL: 45 PERIODS								
TEXT BOOKS:1.PallabNew D2.J. Wils	 TEXT BOOKS: Pallab Bhattacharya "Semiconductor Opto Electronic Devices', Prentice Hall of India Pvt., Ltd., New Delhi, 2006. J. Wilson and J.Haukes, 'Opto Electronics – An Introduction', Prentice Hall, 1995. 									
REFERENCE BO	DOKS:									
 S C Gupta, 'Opto Electronic Devices and Systems', Prentice Hall of India, 2005. Jasprit Singh, 'Opto Electronics – As Introduction to Materials and Devices', Mc Graw-Hill International Edition, 1998 										
3. B. E. A (2007)	A. Saleh and M. C. Teich, 'Fundamentals of Photonics', John Wile h. 'Semiconductor Ontoelectronics: Physics and Technology', McC	ey & Sons, Inc., 2 nd Ed.								
ONLINE RESO	URCES:	ימיי-חווו ווונ., באשיס.								
1. <u>https:</u>	//nptel.ac.in/courses/115/102/115102103/									
2. <u>https:</u>	//nptel.ac.in/courses/117/101/117101054									

														
COUR	SE CO	DE				COUR	SE TITL	E:			L	Т	Р	С
1021	2FF16	54	E	LECTR	ONICS	CIRCUI	T SIMU	LATIO	N AND	РСВ	1	0	A	2
1021		54				DE	SIGN				1	U	4	3
COURSE	CATE	GORY:	Progra	mme E	lective									
PREAM process student PCB layo	BLE: 7 for be s to u out de	The cou etter ur ndersta esign CA	urse is ndersta ind hov D tools	aimed nding a v to de (free c	at ma and des sign a l or licens	king th signing PCB lay sed).	ne stuc of cost vout of	lents t t effect given o	o unde ive Pri circuit	erstand nted Circ using ava	electron cuit Boar ailable ci	ic circu ds. Emp rcuit sir	it simu phasizir mulatio	lation ng the n and
PREREQUISITE COURSES: Nil														
RELATE	D COL	JRSES: /	Analog	Electro	nics, Li	near In	tegrate	ed Circu	uits					
COURSE	EDU	CATION	IAL OBJ	ECTIVE	S:									
The obj	ective	s of the	course	are to	,									
•	Learn different circuit simulation tools used for electronic circuit simulation.													
•	 Understand different PCB layout design and packages. 													
 Understand PCB manufacturing technology and assembly 														
Design and fabricate PCB for a given circuit.														
COURSE OUTCOMES:														
Upon th	e suc	cessful	comple	tion of	the co	urse, st	udents	will be	e able t	0:				
со					<u> </u>						Sk	ill Level		
Nos.				Cour	se Outo	comes				(Bas	sed on D	ave's Ta	axonon	ıy)
CO1	Sim Elec	ulate a	and pe Circuit.	rform	variou	s anal	ysis fo	r the	given			S3		
CO2	Des	ign a PC	CB Layo	ut for t	he give	n circu	lit.					S4		
CO3	CO3 Fabricate the PCB and assemble the components. S2													
CORRELATION OF COs WITH POs AND PSOs														
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	М	Н		Н				М			М	Н	Н
CO2	L	М	Н		Н				М			М	Н	Н
CO3	L	М	Н		Н				М			М	н	Н
COURSE		TENT: T	HEORY	,									•	

Electronics Circuit Simulation

State the features of different circuit simulation tools (Open source or licensed) used for electronic circuit simulation. Different PCB layout design tools (Open source or License) used for PCB layout design. General terms and elements used in circuit simulation software. Assemble electronics circuit using circuit simulation software. Types of Circuit Analysis - Transient Analysis, Bias Point Analysis, Frequency Response.

PCB Layout Design

Terms used: net list file, back annotation, bill of material, foot print, PTH, track width, mil, etc. used in PCB layout design software. Place, route and generate the layout of given circuit using manual or auto routing using PCB layout design software. Raw Materials - Types of PCBs: Single layer - Double layer - Multi layer – Rigid – Flexible - Flex Rigid -High frequency - Aluminium Backed - Track Width Calculation - Layout Design - Back Annotation -Gerber File - NC Drill File - Fab and Assembly Drawings – Legend - Bill of Material. Packaging Trends - Package Classifications - Package Type and Characteristics: Through-Hole Mounting - Surface Mounting - Special Packages- Package Symbols and Codes. Symbols-Reference Designators Values and Attributes-Schematic Design Guidelines-Routing - Nodes – Joints - Design Error Check.

TOTAL:	15	но	URS

LIST OF	EXPERIMENTS	
S. No	CO Mapping	Practical Exercises
1.	CO1	Getting acquainted with simulation tool
2.	CO1	Design a Variable Power Supply Circuit using LM338/LM317
3.	CO1	Design a Hartley Oscillators Circuit and simulate its response
4.	CO1	Design an Astable Multivibrator Circuit and simulate its response
5.	CO1	Design and simulate response of Active and Passive Filter Circuits
6.	CO2	Getting acquainted with PCB layout tool

TOTAL: 30 HOURS

TEXTBOOKS:

- 1. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards, Simon Monk; McGraw Hill Education (1 July 2014)
- 2. Complete PCB Design Using OrCAD Capture and PCB Editor, Kraig Mitzner Newnes; Pap/Cdr edition (28 May 2009), 2011, ISBN: 978-1-4493- 9357-1

List of Major Equipment/Instrument/Software with Broad Specifications

- 1. Altium Designer (Licensed version)
- 2. Express PCB (Free version)
- 3. Eagle (Free version)
- 4. MultiSim (Student Version)
- 5. UtilBoard (Student Version)

ONLINE RESOURCES:

1. www.techdocs.altium.com/

- 2. <u>www.ni.com</u> (Multisim and Ultiboard Academic version)
- 3. <u>www.cadence.com</u> (Orcade Student version)
- 4. <u>www.youtube.com</u> (PCB Manufacturing Videos)

COURS	SE CODE:				COL	JRSE TI	TLE:				L	Т	Р	C
1021	2EE165			N	1EDICA	L ELEC	TRONIC	CS .			3	0	0	3
COURSE	CATEGO	RY: Prog	ramme	Electiv	ve					ľ		•	•	
PREAME physiolo field as v	PREAMBLE: Medical electronics provides the ideas and the basic knowledge of human anatomy, physiology and the need of electronics principle and applications of equipment's used in the medical field as well as introduce the concept of safety aspects for medical instruments.													
PREREQ and Mea	PREREQUISITE COURSES: Linear integrated circuits, Biology for Engineers, Basic Electronics Engineering and Measurements & Instrumentation													
RELATED COURSES: Internet of Things (IoT)														
COURSE	COURSE EDUCATIONAL OBJECTIVES:													
The obje	ectives of	the cour	se are t	:0,										
•	Understa	nd the b	asic cor	ncepts	of hum	an ana	tomy a	nd phy	siology.					
•	Know the electrode	now the classification, application and specification of medical electronic equipments and lectrodes like needle, pad and micro electrodes												
•	 Understand the concept of various transducers, sensors and bio electrical machines like pressure transducers, flow sensor etc., 													
•	 Learn about the patient monitoring systems and measurements like pulse, blood pressure. 													
•	Study abc	ut the ty	pes of	shocks	like m	acro, m	nicro sh	ock an	d the co	oncept	of s	afety a	aspects	
COURSE		IES:												
Upon th	e success	ul comp	letion o	of the c	ourse,	studer	nts will	be able	e to:					
CO Nos.			Cours	se Out	comes				Knowle	dge Le Bloon	evel n's T	(Based axono	d on rev my)	/ised
CO1	Explain physiolo	the bas ogy	sic cond	cepts c	of hum	an ana	ntomy	and			К	2		
CO2	Explain equipm	the prir ents	ciples o	of diffe	erent m	nedical	electro	onic			К	2		
CO3	Discuss the concept of various transducers, sensors and bio electrical machines K2													
CO4	Describe about the patient monitoring systems and K2 measurements													
CO5	Discuss electror	the imp nics and	ortance their st	e of sa andard	lfety as	spects	in med	ical			К	2		
CORREL		COs WI	TH POs	AND F	SOs			I						
COs P	01 PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO9 PO10 PO11 PO12 PSO1 PSC					PSO2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L	I			L							L		
CO2	L	М	М	L	М							М	L	
CO3	М	М	L	М										
CO4	L	L	М	М								М		
CO5	М	М	L	L	М				М		М	М		

COURSE CONTENT:									
UNIT I	REVIEW OF ANATOMY AND PHYSIOLOGY	9							
Elementary ideas of respiratory system	of cell structure, heart and circulatory system, central nervous , body temperature and reproduction system.	system, muscle action,							
UNIT II	OVERVIEW OF MEDICAL ELECTRONICS EQUIPMENTS	9							
Classification, application and specifications of diagnostic, therapeutic and clinical laboratory equipment, method of operation of these instruments. Electrodes: bioelectric signals, bio electrodes, electrode tissue interface, contact impedance, types of electrodes, electrodes used for ECG, EEG, X-Ray & CT-Scan									
UNIT III	9								
Typical signals from physiological parameters, pressure transducer, flow transducer, temperature transducer, pulse sensor, respiration sensor, bio medical recorder block diagram description and application of following instruments, ECG Machine, EEG Machine, EMG Machine.									
UNIT IV APPLICATIONS OF BIOMEDICAL INSTRUMENTS 9									
Heart rate measur measurement, prir	rement, pulse rate measurement, respiration rate measurenciple of defibrillator and pace mark, use of microprocessor in	ement, blood pressure patent monitoring.							
UNIT V	SAFETY ASPECTS OF MEDICAL INSTRUMENTS	9							
Radiation safety in current passage, g safety standards.	strumentation, radiation monitoring instruments, physiologic ross current shock, micro current shock, special design fror	al effects due to 50 Hz n safety consideration,							
		TOTAL: 45 PERIODS							
 TEXT BOOKS: 1. Leislie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, NewDelhi, 2007. 2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGrawHill,New Delhi, 2003. 									
REFERENCE BOOKS:									
 Joseph J. Can and John M. Brown, "Infoddction to Biomedical equipment rectinology", John Wiley and Sons, New York, 2004. Introduction to Biomedical Electronics by Edward J. Perkstein; Howard Bj, USA. 									
 <u>http://electronicsforu.com</u> <u>http://engineering.careers360.com</u> 									

C	OURSE	RSE CODE: COURSE TITLE:									L	Т	Р	C
	10212	EE201			AP	PLIED S	SOFT CO	OMPUT	ING		2	0	2	3
COURS	E CATI	EGORY	: Progra	im Elec	tive									
PREAN logic (F	IBLE: 1 L) and	This cou optimi	urse wi zation t	ll cove echniq	r funda Jues usi	amenta Ing Ger	I conce netic Alg	epts of gorithn	Artific n (GA),	ial Neu PSO, D	ral Net E etc.	works	(ANNs)	, Fuzz
PRERE	QUISIT	e cour	RSES: N	il										
COURS	E EDU	CATION	NAL OB	JECTIV	ES:									
Гhe ob	jective	s of the	e course	e are to),									
٠	Unde	rstand	the fuz	zy logic	c opera	tions, r	elation	s and ii	nferen	ce syste	ems			
•	Unde algori	rstand ithm	the arc	hitectu	ıre, leaı	rning m	rethodo	ologies	of pero	ceptron	and ba	ack pro	pagatic	n
•	Know	basics	ofgen	etic and	d differ	ential e	evolutio	on algo	rithm					
•	Study	differe	ent opti	mizatio	on tech	niques	–PSO,	Firefly,	Artific	ial BEE	algorith	nm etc		
•	Study	soft co	omputir	ng tech	niques	applica	ations r	elated	to elec	trical e	nginee	ring		
COURS		COMES	S: Upon	the su	ccessfu	I comp	letion	of the c	course,	studer	its will I	be able	to:	
со					Course		mes				Knov	wledge n revis	Level	(Base
Nos.					course	Outco	ines					Taxo	onomy)	, iii 3
C01	De co	escribe ontrolle	about r	fuzzific	ation a	and def	fuzzifica	ation ir	n a fuz	zy logic	;		К2	
CO2	Ela co	aborate nsideri	e the ng supe	archite ervised	ecture and ur	of an Isuperv	artific /ised le	cial ne arning	ural n	etwork			К2	
CO3	Ex di	plain th fferenti	ne conc ial evol	ept an ution a	d steps Igorithi	involv m	ed in g	enetic	algoritl	nm and			К2	
CO4	Di to	scuss t apply f	he step for a giv	os of di ven opt	fferent timizati	optim on pro	ization blem	algorit	hms ai	nd how			К2	
CO5	De ele te	evelop ectrical chnique	MATLA engi es	AB base neering	ed sim g pro	ulation	n mode using	els for g soft	solvin t con	g basic nputing			КЗ	
CORRE	LATIO	N OF CO	Os WIT	H POs /	AND PS	Os								
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н	М	М		L							L	М	М
CO2	н	М	М		L							L	М	М
CO3	н	М	м		L							L	М	М
CO1	н	М	м		1		1	1		1	1	1	м	м

CO5

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COURSE CO	NTENT:								
UNIT I	FUZZY LOGIC	7							
Fuzzy sets- fuzzy logic c	logic operations and relation, fuzzy decisions making, fuzzy inference ontroller.	e systems, design of							
UNIT II	ARTIFICIAL NEURAL NETWORKS	7							
Artificial neur	Artificial neuron-Supervised and unsupervised learning-single layer perceptron, and multi-layer perceptron, back propagation neural network.								
UNIT III	EVOLUTIONARY ALGORITHM	7							
Genetic alg Deferential	gorithms: Introduction-genetic algorithm steps-selection, crossov Evolution Algorithm	er, and mutation-							
UNIT IV	SWARM INTELLIGENCE	9							
Particle swa optimization	rm optimization (PSO)-Firefly algorithm (FA), Artificial BEE optimization (CSO)-Bacterial foraging optimization(BFO)	on (ABC) -Cat swarm							
UNIT V	LIST OF EXPERIMENTS	15							
Case studies	s of soft computing applications to electrical engineering problems using	g MATLAB/SCI LAB							
a) App	lication of fuzzy logic for temperature control in refrigerator								
b) Fuzz	y logic controller for speed control of stepper motor								
c) Emu	lating logic gates with a neural network								
d) App	lications of genetic algorithm for speed control of induction motor								
e) Swa	rm intelligence for optimization problem in electrical engineering								
		TOTAL: 45 PERIODS							
TEXT BOOK	5:								
1. S.N.	Sivanandam and S.N.Deepa, 'Principles of Soft Computing', Wiley India	Pvt Ltd, 2011.							
2. Jang	g, J.S.R., Sun, C.T. and Mizutani, E., 'Neuro-fuzzy and Soft Computing: A l	Computational							
REFERENCE									
1. S. Ha	avkin, 'Neural Networks and Learning Machines', Prentice Hall, 2009								
2. S.Ra New	jasekaran, G.A. VijayalakshmiPai,'Neural Networks, Fuzzy Logic & Gene v Delhi	tic Algorithms", PHI,							
3. Deb 2009	, K., 'Optimization for Engineering Design Algorithms and Examples', P 9.	rentice Hall of India.							
4. Geo Hall,	rge J. Klir, Ute St. Clair, Bo Yuan, 'Fuzzy Set Theory: Foundations and A 1997.	pplications' Prentice							

COURSE CODE: 10212EE202

COURSE TITLE: SWITCH MODE POWER SUPPLY DESIGN AND DEVELOPMENT

L	Т	Р	C
2	0	2	3

COURSE CATEGORY: Programme Elective

PREAMBLE: The course is designed as lab dominated theory course to make the student acquire thorough knowledge in the field of power supply design for the given devices or equipments. Since power supply system is absolutely necessary for all equipments which produce constant voltage at the output irrespective of changes in supply voltage. This course is designed from understanding the fundamental of SMPS in designing an SMPS for the given equipments.

PREREQUISITE COURSES: Basic Electronics and Measurement Engineering, Electronic Circuits, and Power Electronics

COURSE EDUCATIONAL OBJECTIVES:

The objectives of this course are to,

- Analyse insight of SMPS and its various topologies
- Design concepts and fabrication of a modern power supply system for the given equipment.

COURSE OUTCOME:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the fundamental concept of SMPS.	К2
CO2	Outline the working of rectifier, chopper, amplifier circuit, voltage and current sensors.	К2
CO3	Explain the SMPS topologies.	К2
CO4	Design SMPS for specific application.	К4
CO5	Identify the power quality issues using power quality analyzer.	К3

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	L						L				М	
CO2	Н	Н	М						L		М	L	М	L
CO3	Н	Н	М						L		М	L	М	Н
CO4	Н	Н	Н	М	М				М		М	L	М	Н
CO5	Н	Н	М	L	М				L		М	L	М	Н

COURSE C	ONTENT:						
UNIT I	INTRODUCTION	6					
Introduction advantage	on to SMPS-types-evolution- need of SMPS- Linear Regulator vs SMPS s-Applications	– Block diagram-					
UNIT II	COMPONENTS USED IN SMPS	6					
Rectifier to regulator a role of cho	vpes and its operations-purpose of amplifier in SMPS-amplifier circuit used and its types-comparator and its types- importance of comparator-Chopper pper in SMPS	in SMPS- voltage - definition-types-					
UNIT III	SMPS CONVERTER TOPOLOGIES	6					
Buck, Boos	Buck, Boost, Buck-Boost, Push-Pull, Fly back, Resonant, forward Converter- Operation.						
UNIT IV	UNIT IV DESIGN OF SMPS						
Selection cycles- cor	of switching devices for SMPS-switching frequency-PWM techniques-switching devices for SMPS-switching frequency-PWM techniques-switching frequency-PWM techniques-swi	tching losses-duty					
UNIT V	POWER QUALITY ASSESSMENT	6					
Power qua harmonics power qua	lity analyzer-block diagram and its working-applications-measurement of co at source side of SMPS -UPS output side-measurement of input power lity issues in load side for single phase and three phase loads	urrent and voltage factor, analysis of					
	T	OTAL: 30 PERIODS					
TEXT BOO	<s:< td=""><td></td></s:<>						
1. Ke Ed	ith Billings, Taylor Morey, 'Switch Mode Power Supply Handbook', 3 rd Ed ucation, New York, 2012.	ition, McGraw-Hill					
2. M 79	aniktala, Sanjaya (2006), 'Switching Power Supplies A to Z', Newnes /Else 70-0	vier, ISBN 0-7506-					
REFERENC	E BOOKS:						
1. Ab Ne	raham I. Pressman, Keith Billingss, Taylor Morey 'Switching Power Supply D w York: McGraw-Hill, 1999	esign', 3 rd Edition,					
2. Of De	I Semiconductor (July 11, 2002), 'SWITCHMODE Power Supplies—Refere sign Guide' (PDF). Retrieved 2011-11-17.	ence Manual and					
LIST OF EX	PERIMENTS TC	TAL: 30 PERIODS					
1. Ide	entification, testing of components and its terminals used in SMPS						
2. a.	Selection of energy storage inductor, output filter capacitor.						
b.	Study the working of various high frequency switching devices						
3. a.	Selection of switches, snubber circuit design						
b.	Study of Magnetic circuits and Transformer						
4. To	Generate Pulse width modulation signal using different circuits						
5. a.	Design of feedback controller and amplifier circuit						
b.	Op-amp circuits for current and voltage sensing in converters.						
6. a.	Measurement of output voltage using voltage sensor						

- b. Study the working of tiny fly back step down transformer
- 7. Design and testing of a voltage regulator circuit
- 8. Design and testing of simple DC chopper
- 9. Design of non-isolated DC-DC converters in different operating modes
- 10. Microcontrollers selection to use in SMPS circuits
- 11. Study of popular PWM Control IC's (SG 3525,TL 494,MC34060 etc.)
- 12. Study of popular PFC Control ICs MC34062 and UC 3854
- 13. Design of driver circuits
- 14. Design and development of SMPS and measure the input power factor and THD of input voltage and current using a power quality analyzer.
- 15. Troubleshooting of SMPS.

	COUI	RSE CO	DE:			FI	COL	IRSE TI	LE:	ç		L 2	T	P 7	C 2			
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											himan	») 	+	the end	f			
speed c	ontrol	s, and A	Applicat	ions	wiii get	. expos		ectrical	DCQ		liines (.oncep	is, me	linou	5 01			
PREREC	PREREQUISITE COURSES: Basic Electrical Engineering																	
RELATED COURSES: Electrical Machine Design																		
COURSE EDUCATIONAL OBJECTIVES:																		
The obj	ectives	of the	course	are to	make t	he stud	dents,											
•	• To gain the knowledge on the construction and principle of operation of DC generators.																	
•	• To analyse the performance characteristics of DC motors.																	
•	To un	derstan	id the c	oncept	, opera	ition an	id equi	valent o	circuit o	of trans	former	S.						
•	To exp	blain th	e conce	ept of s	ynchro on and	nous m charact	achine	S.	lo nha	co and	noly nt	naco in	ductio	^				
•	motor	S.		peratic					sie pria	se anu	poly pi	1030 111	uuctio	1				
COURS		OMES	:															
Upo	on the	success	ful con	npletio	n of the	e cours	e, stude	ents wi	ll be ab	le to:								
CO Nos.				С	ourse (Outcom	nes				Know on	ledge I revise Taxor	Level d Bloo nomy)	Base m's	ed			
C01	Exp ger	olain th nerator:	ne con: s	structio	on and	princi	iple of	opera	tion o	f DC		K	2					
CO2	Ana	alyse th	o norfc	ormanc	e chara	generators Analyse the performance characteristics of DC maters (2)												
CO3	Understand the concept, operation and equivalent circuit of transformers.							C moto	ors			K	К2					
	tra	derstar nsform	nd the c ers.	oncept	, opera	ition ar	ics of D nd equi	C moto valent o	ors circuit (of		ĸ	2					
CO4	tra Exp	derstar nsform plain the	nd the c ers. e conce	oncept	, opera	ition ar	ics of D nd equi achine	C moto valent o s.	ors circuit (of		к к	2 2 2					
CO4 CO5	Exp Uni and	derstar nsform blain the derstar d poly p	nd the c ers. e conce nd the c bhase in	ept of superation	ynchroi on and n moto	nous m charact	ics of D nd equir achine teristic	C moto valent o s. s of sing	ors circuit o gle pha	of se		к к к	2 2 2 2					
CO4 CO5	Un Exp Un and	derstar nsform plain the derstar d poly p I OF CC	e period ers. e conce nd the c phase in Ds WITH	ept of soperation operation duction	ynchroi on and n moto	nous m charact	ics of D nd equir achine teristic	C moto valent o s. s of sing	ors circuit o gle pha	se		K K	2 2 2 2					
CO4 CO5 CORREI	Uni and ATION	derstar nsform plain the derstar d poly p I OF CC PO2	e conce ers. e conce od the c ohase in os WITH PO3	oncept ept of soperation iduction I POs A PO4	ynchroi on and n moto ND PS(PO5	nous m charact rs. Ds PO6	ics of D nd equi achine teristics PO7	C moto valent o s. s of sing PO8	ors circuit o gle pha PO9	of se PO10	P011	к к к РО12	2 2 2 2 PSO1	PSO	02			
CO4 CO5 CORREI COs CO1	LATION H	derstar nsform blain the derstar d poly p l OF CC PO2 H	e conce ers. e conce od the c ohase in Ds WITH PO3 M	oncept ept of s operatio ductio I POs A PO4	ynchroi on and n moto ND PSC	nous m charact rs. Ds PO6	ics of D nd equi achine teristic: PO7	C moto valent o s. s of sing PO8 L	ors circuit o gle pha PO9 M	of se PO10	P011	к к к РО12	2 2 2 2 PSO1 H	PS0	D2			
CO4 CO5 CORREI COs CO1 CO2	ATION H	derstar nsform blain the derstar d poly p l OF CC PO2 H H	e conce ers. e conce od the c ohase in DS WITH PO3 M M	oncept ept of s operation duction I POS A PO4 M	ynchroi on and n moto ND PS(nous m charact rs. Ds PO6	ics of D nd equi achine teristic: PO7	C moto valent o s. s of sing PO8 L L	ors circuit o gle pha PO9 M M	pof se PO10 L L	P011	к к к РО12	2 2 2 2 72 72 72 72 72 72 72 72 72 72 72	PSC N	D2 1			
CO4 CO5 CORREI COs CO1 CO2 CO3	LATION H H H	derstar nsform ilain the derstar i poly p i OF CC PO2 H H H	e period ers. e conce od the c ohase in DS WITH PO3 M M M	oncept operation iduction I POS A PO4 M L	ynchroi on and n moto ND PS(nous m charact rs. PO6	ics of D nd equi achine teristic: PO7	C moto valent o s. s of sing PO8 L L L	ors circuit o gle pha PO9 M M M	PO10 L L L	P011	к к к РО12	2 2 2 72 72 72 72 72 72 72 72 72 72 72 7	PSC N N	D2 1 1			
CO4 CO5 CORREI CO5 CO1 CO2 CO3 CO4	LATION H H H	derstar nsform plain the derstar poly p I OF CC PO2 H H H H	e conce ers. e conce ohase in DS WITH PO3 M M M	oncept operation iduction I POS A PO4 M L L	ynchroi on and n moto ND PS(PO5	nous m charact rs. Ds PO6	ics of D nd equi achine teristic: PO7	C moto valent o s. s of sing PO8 L L L L	rs circuit o gle pha PO9 M M M M	pof se PO10 L L L L	P011	к к РО12	2 2 2 72 PSO1 H H H	PSC N N N	D2 1 1 1			
CO4 CO5 CORREI CO5 CO1 CO2 CO3 CO4 CO5	LATION H H H H H	derstar nsform plain the derstar poly p I OF CC PO2 H H H H H	e period ers. e conce od the c ohase in DS WITH PO3 M M M	oncept operation iduction I POS A PO4 M L L L H	ynchroi on and n moto ND PS(PO5	nous m charact rs. Ds PO6	ics of D ad equi achine teristic:	C moto valent o s. s of sing PO8 L L L L L L	rs circuit o gle pha PO9 M M M M M	pof se PO10 L L L L L	P011	к к РО12	2 2 2 72 72 72 72 72 72 72 74 74 74 74 74 74 74 74 74 74 74 74 74	PSC N N N N	D2 1 1 1 1			

COURSE CO	ONTEN	NT:	
UNIT I	I	DC GENERATORS	6
Construction generators Commutat	on an s, Typ tion.	d Principle, Methods of excitation, Magnetization and operating chara es, EMF equation Armature Reaction– Commutation – methods o	cteristics of f improving
UNITI	I	DC MOTORS	6
Principle o and compo	of oper ound n	ation – Back EMF and torque equation – Characteristics and application of s notors – starting of dc motors – Types of starters, Losses and efficiency.	series, shunt
UNIT II	11	TRANSFORMERS	6
Theory and Performan	d oper ice est	ration, EMF equation, Phasor diagram, equivalent circuit, open and short imation, Parallel operation, three phase transformer connections. Auto-trar	circuit tests. Isformers.
UNIT IN	v	SYNCHRONOUS MACHINES	6
Alternators regulation	s - typ by EM	pes and constructional features - EMF equation, Concept of synchronou IF and MMF methods, Synchronous motor starting and V curves.	s reactance,
UNIT	/		6
Poly phase control.	e Induc	ction motors - types and constructional features - equivalent circuit - startin	g and speed
revolving f	field th	eory. Applications of induction motors.	
		TOTAL:	30 PERIODS
LIST OF EXP	PERIM	ENTS (30 PERIODS)	
1. On	pen cire	cuit and load characteristics of D.C self-excited shunt generator	
2. Lo	ad cha	aracteristics of D.C shunt motor	
3. Sp	eed co	ontrol of D.C shunt motor	
4. Op	oen cir	cuit and short circuit tests on single phase Transformer	
5. Loa	ad test	t on three phase Transformer	
6. De	etermir	nation of voltage Regulation of three phase alternator by EMF and MMF me	thods
7.Va	and Inv	verted V curves of Three Phase Synchronous Motor	
8. Lo:	ad test	t on three-phase induction motor	
9. Sp	eed co	ontrol of three phase Slip ring Induction motor	
10. Lo	ad test	t on single-phase induction motor	

TEXT BOOKS:

- 1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.
- 2. Nagrath, I.J.and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.

REFERENCE BOOKS:

- 1. Arthur Eugene Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw Hill Education Publications, 6th Edition, 2002.
- 2. Vincent Del Toro, 'Electrical Engineering Fundamentals', 2nd Edition, Prentice hall Publications, 2003.
- 3. Parkar Smith, N.N., 'Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributers, 1984.
- 4. https://elearn.nptel.ac.in/shop/nptel/electrical-machines/

С	OURSE	CODE:				COU	RSE TIT	LE:			L	Т	Р	C
	10212	EE301		v	OLTAG	E STAB	ILIZER	FABRIC	CATION		0	0	2	1
OURS	E CATI	EGORY:	Progra	mme E	lective									
REAM ouse tabilize	1BLE: T hold er to d	his cou applian esignin	rse incl ces. Th g a volt	udes th iis cou age sta	ne deve rse is Ibilizer	lopme design for the	nt of sk ed fro given p	ills in p m und power r	ower s erstand ating.	upply u ding th	unit wh Ie fund	ich is e lament	ssentia al of v	l for a /oltag
REREC	QUISIT	E COUF	RSES: Ba	asic Ele	ctronic	s and N	leasur	ement	Engine	ering				
OURS	E EDU	CATION	IAL OBJ	IECTIVE	S:									
he obj	jective	s of this	s course	e are to	,									
•	Ident	ify the r	require	ment o	f voltag	ge stabi	lizer fo	r dome	estic eq	uipmer	nts.	:1:		
•	Proce	dure to	or the d	esign o	f relay	driver o	given j circuit f	or volta	age sta	bilizer	ge stat	mzer		
•	Techr	niques f	or trou	ble sho	, oting t	he volt	age sta	bilizer	for any	proble	m			
OURS	E OUT	COMES	:											
Up	on the	succes	sful cor	npletio	n of the	e cours	e, stud	ents wi	ll be at	ole to:				
со				6							Level o	f learni	ing don	nain
Nos	.			C	burse C	Jutcom	es			(1	based o	taxono	my)	om s
CO1	1 E	xplain t	he basi	ic conce	epts of	voltage	e stabili	zer				K2, S	51	
CO2	2 E	uild a t	ransfor	mer foi	r voltag	e stabi	lizer					K3, S	2	
COB	3 В	uild of	relay dı	river cir	cuit							K3, S	52	
CO4	1 Г)emons	trate vo	oltage s	tabilize	or for sr	necific :	annlica	tion			кз 5	3	
0								applied				10,0		
COS	5 [emons	trate tr	oubles	hooting	g of vol	tage sta	abilizer				K3, S	3	
ORRE	LATIO	N OF CO	Ds WITH	H POs A	ND PS	Os								
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO
CO1	Н	L										L	Н	L
CO2	Н	L	L						М	L			L	Н
CO3	Н	L	L						М	L			L	Н
CO4	Н	L	М						М	М	М	L	М	Н
		H L M H H H												

DESIGN OF VOLTAGE STABILIZER

Introduction-Need of voltage stabilizer-Power rating calculation-Block diagram- complete circuit and its operation -Relay driver circuit design-Comparator Design-Transformer design

LIST OF EXPERIMENTS

- 1. Identification of components and its terminals used in voltage stabilizer.
- 2. Design and development of transformer for given power rating.
- 3. Design and development of comparator circuit for voltage stabilizer.
- 4. Design and development of relay driver circuit used in voltage stabilizer.
- 5. Voltage measurement using voltage sensor.
- 6. Design of amplifier circuit for voltage stabilizer.
- 7. Demonstration and testing of voltage stabilizer for various input voltage.
- 8. Trouble shooting of voltage stabilizer.

TOTAL: 30 PERIODS

TEXT BOOKS:

 M. Lotia 'Modern Voltage Stabilizer Servicing: Introduction, Basic Principle and Repairing', ISBN 10: 8176562831 / ISBN 13: 9788176562836, BPB Publications, 2006.

REFERENCE BOOKS:

 Osama Butt 'Automatic Voltage Stabilizer by Using Pulse Width Modulation', ISBN 10: 365989317X / ISBN 13: 9783659893179, Published by LAP Lambert Academic Publishing, 2016.

OPEN ELECTIVES

List of Courses	(12 Credits)
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.NO.		COURSE NAME	L	т	Р	С
	CODL					
1.	10213EE101	Neural Network and Fuzzy Logic Control	3	0	0	3
2.	10213EE102	Bio Medical Instrumentation	3	0	0	3
3.	10213EE103	Introduction to Automation	3	0	0	3
4.	10213EE104	Virtual Instrumentation	3	0	0	3
5.	10213EE105	Finite Element Analysis	3	0	0	3
6.	10213EE106	EMI and EMC Techniques	3	0	0	3
7.	10213EE107	Power Supply Quality	3	0	0	3
8.	10213EE108	Led Lighting	3	0	0	3
9.	10213EE109	Transducers and Sensors	3	0	0	3
10.	10213EE110	Signals and Systems	3	0	0	3
11.	10213EE111	Wearable Electronics	3	0	0	3
12.	10213EE112	Embedded System	3	0	0	3
13.	10213EE113	Estimation for Electrical Wiring	3	0	0	3
14.	10213EE114	Renewable Energy Systems	3	0	0	3
15.	10213EE115	Automotive Electrical and Electronics Systems	3	0	0	3
16.	10213EE116	Hybrid Electric Vehicles	3	0	0	3
17.	10213EE117	Introduction to Robotics	3	0	0	3
18.	10213EE118	Standards, Calibration, Testing and Maintenance of Electrical Equipment's	3	0	0	3
19.	10213EE119	Electrical Safety, Operation and Regulations	3	0	0	3
20.	10213EE120	Energy Conservation and Management	3	0	0	3
21.	10213EE121	Electrical Machines	3	0	0	3
22.	10213EE122	Industrial Electrical Systems	3	0	0	3
23.	10213EE123	Computer Aided Analysis of Electrical Apparatus	3	0	0	3
24.	10213EE124	Green Energy Resources	3	0	0	3
25.	10213EE125	Robotics and Automation	3	0	0	3
26.	10213EE126	Wind Energy Technology	3	0	0	3
27.	10213EE127	Electrical Safety and Safety Management	3	0	0	3
		INTEGRATED COURSES				
28.	10213EE201	Switch Mode Power Supply Design and Development	2	0	2	3
	[LABORATORY COURSES				
29.	10213EE301	Voltage Stabilizer Fabrication	0	0	2	1

COURSE CODE:	COURSE TITLE:	L	т	Ρ	С
10213EE101	CONTROL	3	0	0	3

COURSE CATEGORY: Open Elective

PREAMBLE: This course Fuzzy Logic and Neural network require understand the concept of fuzziness involved in various systems and fuzzy set theory and neural network.

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

• To cater the knowledge of Fuzzy Logic and Neural Networks in real time systems

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Illustrate the concepts of feed forward neural networks	К2
C02	Explain the importance of feedback networks and specify the applications of neuro controller for various applications	К2
C03	Analyze and compare fuzzy set theory with conventional set theory	КЗ
C04	Explain fuzzy systems and the structure of fuzzy logic controller.	К2
C05	Identify various applications of fuzzy logic control to real time systems.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	М	Н	М		L									
CO2	М	Н	М		L									
CO3	М	Н	М		L									
CO4	М	Н	L		L									
CO5	М	Н	L		L								М	М

COURSE CONT	'ENT:	
UNIT I	INTRODUCTION TO NEURAL NETWORKS	9
Introduction – Multi layer fee	Biological neuron – Artificial neuron – Neuron modeling – L d forward network – Back propagation – Learning factors.	earning rules – Single layer –
UNIT II	NEURAL NETWORKS FOR CONTROL	9
Feedback netw Applications c inverted pend	works – Hop field networks – Associative memories and A of artificial neural network - Process identification – Neuro ulum problem.	daptive Resonance Theory – o controller – Application to
UNIT III	FUZZY SYSTEMS	9
Classical sets Fuzzification –	vs Fuzzy sets – Operation in fuzzy sets– NOT, AND and OR Defuzzification – Fuzzy rules	operators - Fuzzy relations –
UNIT IV	FUZZY LOGIC CONTROL	9
Elements of F Adaptive fuzzy	uzzy logic Control - Membership function – Knowledge ba v system - Introduction to neuro fuzzy controller	se – Decision-making logic –
UNIT V	APPLICATION OF FLC	9
Fuzzy logic cor – Blood pressu	ntrol – Washing Machine - Inverted pendulum – Image proce Ire during anesthesia	ssing – Home heating system
		TOTAL: 45 PERIODS
TEXT BOOKS:		
 Jacek Timot 	M. Zurada, 'Introduction to Artificial Neural Systems', Jaico P hy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata N	ublishing Home, 2002. 1cGraw Hill, 1997.
REFERENCE BO	DOKS:	
 Laurar Educa H.J. Zir Simon John Y New E 	nce Fausett, Englewood cliffs, N.J., 'Fundamentals of tion, 1992. mmermann, 'Fuzzy Set Theory & its Applications' Allied Publi Haykin, 'Neural Networks', Pearson Education, 2003. 'en & Reza Langari, 'Fuzzy Logic – Intelligence Control & Info Delhi, 2003.	Neural Networks', Pearson cation Ltd., 1996. rmation', Pearson Education,

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE102	BIO MEDICAL INSTRUMENTATION	3	0	0	3
COURSE CATEGORY: Op	en Elective				

PREAMBLE: The course is designed to make the student acquire an adequate knowledge of the physiological systems of the human body and relate them to the parameters that have clinical importance. The fundamental principles of equipment that are actually in use at the present day are introduced.

PREREQUISITE COURSES: Basic Electronics and Measurement Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To provide an acquaintance of the physiology of the heart, lung, blood circulation and circulation respiration. Methods of different transducers used.
- To introduce the student to the various sensing and measurement devices of electrical origin.
- To provide the latest ideas on devices of non-electrical devices.
- To provide latest knowledge of Pulmonary Measurement & Bio Telemetry.
- To bring out the important and modern methods of imaging techniques.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	To emphasize an acquaintance of the physiology of the heart, blood circulation and circulation respiration and the methods of different transducers used.	К2
C02	To demonstrate student to the various sensing and measurement devices of electrical origin and Instruments for checking safety parameters	К3
C03	To understand the latest ideas on devices of non-electrical devices.	К3
C04	To apply the latest knowledge of Pulmonary Measurement & Bio Telemetry.	К2
C05	To highlight the important and modern methods of imaging techniques and biometric system.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		Н								М		L	М
CO2	М							L			L		L	
CO3			М								М			
CO4			Н					М			М			
CO5			М										L	М

COURSE	CONTENT:	
UNIT I	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	9
Cell and biomedic mechanic transduce	its structure – Resting and Action Potential – Nervous system – al system- Cardiovascular systems- Respiratory systems - Biomechan is of spinal column and limbs- Transducers – selection criteria – ers - Temperature measurements - Fibre optic temperature sensors.	Basic components of a ics of soft tissues - Basic Piezo electric, ultrasonic
UNIT II	BIOMEDICAL MEASUREMENT	9
Electrode hazards –	s –types-Amplifiers - ECG – EEG – EMG – ERG - Electrical safety in me leakage current-Instruments for checking safety parameters of biome	dical environment, shock dical equipments.
UNIT III	NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES	9
Measurer measurer pH of blo	ment of blood pressure - Cardiac output - Heart rate - Heart sour nents – spirometer – Photo Plethysmography, Body Plethysmograph od –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR	nd - Pulmonary function y – Blood Gas analysers, measurements.
UNIT IV	PULMONARY MEASUREMENT AND BIO TELEMETRY	9
Physiolog Biotelemo hazards a	y of respiratory system – Respiratory rate measurement – wire and wi etry – Telemetering multiple information – implanted transmitter nd safety techniques.	reless s – causes of electrical
UNIT V	MEDICAL IMAGING SYSTEM	9
Ultrasour Cine angi	nd scanner – Echo cardiography – Coloar Doppler system – CAT and oppram – LASER Imaging – Endoscope.	CT scan – MRI Imaging –
		TOTAL: 45 PERIODS
TEXT BOO	DKS:	
1. La D 2. Ja V	eslie Cromwell, 'Biomedical Instrumentation and Measurement', Pre elhi, 2007. oseph J.carr and John M. Brown, 'Introduction to Biomedical Equip /ileyand Sons, New York, 4 th Edition, 2012	entice Hall of India, New oment Technology', John
REFEREN	CE BOOKS:	
1. K E 2. Jo	handpur R.S, 'Handbook of Biomedical Instrumentation', Tata McG dition, 2003 ohn G. Webster, 'Medical Instrumentation Application and Design', Jo	braw-Hill, New Delhi, 2 nd
Y 3. D 4. N	ork, 1998. uane Knudson, 'Fundamentals of Biomechanics', Springer, 2 nd Edition, 1.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003	2007.

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE103	INTRODUCTION TO AUTOMATION	3	0	0	3
COURSE CATEGORY: Op	en Elective				

PREAMBLE: This course is designed to provide the knowledge on recent trends in automation techniques (Programmable Logic Controllers & Distributed Control Systems deployed in the various core industries and research organization).

PREREQUISITE COURSES: Nil

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- Realize the working, design and need of timers, counters, various memories and their efficient managing techniques.
- Relate the automation techniques to real world engineering applications.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Illustrate the basics of PLCs	К2
CO2	Design Ladder Diagram by programming the timers and counters.	К3
CO3	Design the PLCs addressing applications and research problems.	К3
CO4	Exemplify the basics and design of DCS	КЗ
CO5	Integrating various components to DCS to execute Automation	К2

		104	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
L	М	М	М									
н	М	Н		М		L						
L	L	М		L		М						L
L	М	М	М									
L	L			М								М
	H L L	H M L L L M	L M M H M H L L M L M M L L M	L M M H M H L L M L M M L L M	L M M M H M H M L L M L L M M M L M M M L M M M	L M	L M M M H M H M L L M L L M M L M M	L M M M H M H M L L M L L M M M L M M L M M	L M M M H M H M L L M L L M M M L M M L M M	L M M M H M H M L L M L L M M M L M M M L M M M	L M M M H M H M L L M L M M L M M L M M L M M	L M M M H M H M L L M L M M L M M L M M L M M

COURSE C	ONTENT:	
UNIT I	PROGRAMMABLE LOGIC CONTROLLER	9
Evolution	of PLC's – Components of PLC – Advantages over relay logic - PLC pro	gramming languages
UNIT II	PROGRAMING IN PLC	9
Ladder dia	gram – Programming timers and counters – Design of PLC.	
UNIT III	APPLICATIONS OF PLC	9
Instruction PC as PLC	ns in PLC – Program control instructions, math instructions, sequend – Application of PLC – Case study of bottle filling system	cer instructions – Use of
UNIT IV	DISTRIBUTED CONTROL SYSTEMS (DCS)	9
Definition languages	, architecture (centralized, hybrid generalized DCS) Local Control Uni , LCU – Process interfacing issues, communication facilities, configura	t (LCU) architecture, LCU tion of DCS.
UNIT V	INTERFACES IN DCS	9
Operator interfaces	interfaces - Low level and high level operator interfaces – Operato – Low level and high level engineering interfaces – General purpose of	or displays - Engineering computers in DCS.
		TOTAL: 45 PERIODS
TEXTBOO	KS:	
1. Fr 2. Ge	ank Petruzella, 'Programmable Logic Controllers', 3 rd Edition, Tata Mo eorge Bolton, 'Programmable Logic Controllers', 5 th Edition, Elsevier Ir	Graw Hill Publications.
REFERENC	E BOOKS:	
1. W 2. Ha	ebb John W, Reis Ronald A 'Programmable Logic Controllers', PHI lea ackworth 'Programmable Logic Controllers: Programming Method lition, Pearson India Publications.	rning Pvt Ltd. ds and Applications' 1 st

COUI	RSE CODE:	COURSE TITLE:	L	Т	Р	C
102	13EE104	VIRTUAL INSTRUMENTATION	3	0	0	3
COURSE C	ATEGORY: Open	Elective				
PREAMBL	E : To study the c	concept of virtual instrumentation using software I	angua	ge		
COURSE E	DUCATIONAL OF	3JECTIVES:				
The objec	tives of the cours	se are to make the students,				
• To	o study the prin	nciples and techniques of windows programmin	g usin	g MFC,	proced	dures
re	sources, control	s and database programming through the visual	langua	iges, Vi	sual C+	+ and
Vi	sual Basic.		-			
COURSE C	OUTCOMES :					
U	pon the successf	ul completion of the course, students will be able t	:0:			
CO				Level of	learniı	ng
Nos.		d	domain (Based on revised Bloom's)			
CO1	Comprehend	the concept of analog signals in digital domain.			<2	<u>.</u>
<u> </u>	Apply Calibrat	tion and Resolution for analog inputs and output	ts		()	
02	using DAQ.				(3	
CO3	Interface the	external instruments to PC by selecting th	e	I	<3	
	appropriate o	n communication bus.			-	
~~ /	Gain a vast kn	owledge of graphical programming techniques.		I	<2	
C04						
CO4 CO5	Develop progr	ram for simple applications using VI		I	<5	

CORRELATION OF COs WITH POs AND PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	М													
CO2	М	Н	н		Н									
CO3	М	Н	Н		Н									
CO4	М	L			Н									
CO5	М	Н	н		Н									
COURSE CONTENT:														
UNIT I REVIEW OF DIGITAL INSTRUMENTATION											9			
Representation of analog signals in the digital domain – Review of quantization in amplitude and time –														

Representation of analog signals in the digital domain – Review of quantization in amplitude and time – Sample and hold –Sampling theorem – ADC and DAC

UNIT II	UNIT II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION								
Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency – Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs – Concept of universal DAQ card – Use of timer-counter and analog outputs on the universal DAQ card									
UNIT III	UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM								
Interfacing of ex standard – ISO-O	standards – IEEE 488 s and CAN bus								
UNIT IV	GRAPHICAL PROGRAMMING ENVIRONMENT IN VI	9							
Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI – Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures – Types of data – Arrays – Formulae nodes – Local and global variables – String and file I/O									
UNIT V	ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI	9							
Fourier transform – Power spectrum – Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – PID controller – CRO emulation – Simulation of a simple second order system – Generation of HTML page									
		TOTAL: 45 PERIODS							
TEXTBOOKS:									
 Gupta, S. and Gupta, J.P., 'PC Interfacing for Data Acquisition and Process Control', Instrument Society of America, 1994. Deter W. Coffee, (Understanding Corrigh Communications), Control (2001) 									
2. Feter W. Gorton, Understanding Senar Communications, Sybex International, 1994.									
REFERENCE BOOKS:									
1. Robert H	. Bishop, 'Learning with Labview', Prentice Hall of India, 2003.								
2. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newnes, 2000.									
 Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw-Hill Professional Publishing, 2001. 									
L									

COURSE CODE:			COURSE TITLE:								Т	Р	C			
10213EE105				FINITE ELEMENT ANALYSIS								0	3			
COURSE CATEGORY: Open Elective																
PREAN	IBLE : 1	This cou	ırse wil	l explo	re the k	basic co	oncept	of discr	ete an	d contir	nuous e	elemen	t analys	sis		
COURS	E EDU		IAL OB.	JECTIVE	ES:											
•	To int	roduce	the co	ncept c	of nume	erical a	nalysis	of stru	ctural c	ompor	ents					
COURS	E OUT	COMES	:													
	Upon	the su	ccessfu	l compl	letion o	of the c	ourse, s	student	s will t	e able	to:					
со					0							Level of learning				
Nos.				Course Outcomes								domain (Based on revised Bloom's)				
CO	1	Understand the criteria of finite element method									К2					
CO2	2	Explain about the basics of discrete elements								К2						
COS	3	Describe about the continuum elements K2														
CO4	1	Explain about the applications of isoperimetric elements K2														
CO5 Understand the				e applic	applications to other field problems							К2				
	1										1					
CORRELATION OF COs WITH POs AND PSOs																
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	М						L									
602			Ц		Ц	1				Ц						
02			п		п	L				п						

UN	ITI	INTE	INTRODUCTION										
COURSE CONTENT:													
CO5	М		Н		Н								
CO4	L	L			М	М		М					
CO3	L	Н	Н				Н		Н				

Review of basic analysis – Stiffness and Flexibility matrix for simple cases – Governing equation and convergence criteria of finite element method.

UNIT II	DISCRETE ELEMENTS	9							
Bar, Frame, beam elements – Application to static, dynamic and stability analysis.									
UNIT III	CONTINUUM ELEMENTS 9								
Various types of 2-D-elements Application to plane stress, plane strain and axisymmetric problems									

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9

Μ
UNIT IV	ISOPARAMETRIC ELEMENTS	9								
Applications t	o two and three-dimensional problems									
UNIT V	FIELD PROBLEM	9								
Applications to other field problems like heat transfer and fluid flow.										
	т	OTAL: 45 PERIODS								
TEXTBOOKS:										
1. Tirupa Engin	athi.R. Chandrapatha and Ashok D. Belegundu, 'Introduction to F eering', Prentice Hall India, 3 rd Edition, 2003.	Finite Elements in								
2. Reddy	J.N. 'An Introduction to Finite Element Method', McGraw-Hill, 2000.									
REFERENCE B	OOKS:									
1. Krishı	namurthy, C.S., 'Finite Element Analysis', Tata McGraw-Hill, 2000.									
2. Bathe India,	 Rishnanderity, e.s., Finite Element Analysis, Fata Mediaw-Finit, 2000. Bathe, K.J. and Wilson, E.L., 'Numerical Methods in Finite Elements Analysis', Prentice Hall of India, 1985. 									

CO	URSE	CODE: COURSE TITLE: L											Р	C			
1	0213E	E106		EMI & EMC TECHNIQUES 3										3			
COURS	SE CAT	EGORY	Open	Elective	9												
PREAM	PREAMBLE: This course will enable the students to understand power quality issues in power systems.																
COURS	COURSE EDUCATIONAL OBJECTIVES:																
The ob	The objectives of the course are to make the students,																
•	• To acquire knowledge of non linear loads.																
 To acquire knowledge of different converter circuits used in power systems 																	
• To walk around the various applications and stability analysis in power systems.																	
COURS	COURSE OUTCOMES :																
Up	on th	e succes	sful cor	mpletio	n of th	e cours	se, stud	lents wi	ll be al	ole to:				. 1			
СС)	Course Outcomes dor										Level o Iomair	of learn (Based	learning (Based on			
Nos	s.		Course Outcomes do											f learning (Based on Bloom's) K2 K2 K2 K2 K2 K2 FSO1 PSO2			
СО	CO1 Understand the basic idea behind EMI and EMC												K2				
CO	CO2 Gain knowledge about grounding techniques.												К2				
CO	CO3 Gain knowledge on the importance of shielding. K2																
CO	4	Underst	and the	e conce	epts of o	digital	circuit ı	noise.					K2				
CO	5	Gain kn	owledg	e on in	dustria	l and g	overnm	nent sta	indards	s for EN	11		К2				
CORRE	LATIC	ON OF CO	Os WIT	H POs A	AND PS	Os	-	-		-			-				
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2			
CO1	L	L		L					L								
CO2	L								L		L						
CO3	Н	Н				М	М			Н	L						
CO4	Н		М														
CO5	Н	Н		Н					Н								
COURS	SE COI	NTENT:															
UNIT I INTRODUCTION 9)							
Sources of EMI, Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation- typical noise path- use of network theory- methods of eliminating interferences																	
UNIT	. 11	METHO	DD OF H	IARDEN	NING								9)			
Cabling			a a u vali	محت انمما		a a u a li	ma ah	ت ما ما نه م	+				liation	مامناط			

Cabling –capacitive coupling- inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds- single point and multipoint ground systems- hybrid grounds- functional ground layout –grounding of cable shields- ground loops-guard shields.

UNIT III	BALANCING, FILTERING AND SHIELDING	ANCING, FILTERING AND SHIELDING 9								
Power supp and far field conductive	Power supply decoupling - decoupling filters-amplifier filtering –high frequency filtering shielding – near and far fields- shielding effectiveness- absorption and reflection loss, Shielding with magnetic material- conductive gaskets, windows and coatings- grounding of shields.									
UNIT IV	DIGITAL CIRCUIT NOISE AND LAYOUT	9								
Frequency versus time domain- analog versus digital circuits- digital logic noise- internal noise sources- digital circuit ground noise –power distribution-noise voltage objectives- measuring noise voltages- unused inputs-logic families.										
UNIT V	UNIT V ELECTROSTATIC DISCHARGE, STANDARDS AND LABORATORY 9									
Static Gener EMC, Indust techniques-	Static Generation- human body model- static discharges-ED protection in equipment design- ESD versus EMC, Industrial and Government standards – FCC requirements – CISPR recommendations-Laboratory techniques- Measurement methods for field strength-EMI.									
	тот	AL: 45 PERIODS								
TEXTBOOKS	:									
 Henry W.Ott, 'Noise Reduction Techniques in Electronic Systems', John Wiley & Sons, 1989. Bernhard Keiser, 'Principles of Electro-magnetic Compatibility', Artech House, Inc. 1987. 										
REFERENCE	BOOKS:									
1. Bridges, J.E Milleta J. and Ricketts.L.W, 'EMP Radiation and Protective Techniques', John Wiley										

and Sons, USA 1976.2. IEEE National Symposium on 'Electromagnetic Compatibility', IEEE, 445, Hoes Lane, Piscataiway,

NJ 08855.

COURS	E CODE:		L	т	Р	С					
10213	BEE107	POWER SUPPLY QUALITY		3	0	0	3				
COURSE CA	ATEGORY: Op	en Elective									
PREAMBLE quality, the	: This course eir sources, ef	provides knowledge on need for power supply quality, fects and solutions.	, facto	rs affe	ecting	the p	ower				
PRE-REQUI	ISITES : Basic	Electrical Engineering									
COURSE ED	DUCATIONAL	OBJECTIVES:									
To impart k	knowledge or	1									
• To	provide knov	vledge on importance of power supply quality.									
• To	educate the I	power quality phenomena, sources and its effects.									
• To	• To understand the role of power quality standards and charts.										
• To	demonstrate	the types of linear and nonlinear loads.									
• To	brief about p	ower conditioning devices and monitoring systems.									
COURSE O	UTCOMES:										
Upon the c	ompletion of	the course students will be able to									
CO Nos.		Course Outcomes	Leve (Bl	el of le Based loom's	arning on re taxo	g dom vised nomy	ain)				
CO1	Explain the i	mportance of Power Quality			К2						
CO2	Describe about power quality problems, categories, causes and its k2 k2										
CO3	CO3 Interpret the role of power quality standards and charts K2										
CO4	Demonstrat	e the various types of linear and nonlinear loads			К2						
CO5	Summarize Power Conditioning devices and Power Quality K2										

Monitoring systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			М										L	
CO2			М										М	L
CO3			М											
CO4	L		Н									Н		
CO5			Н	Н								М	L	L

COURSE CONTENTS											
UNIT I	INTRODUCTION	9									
Evolution of Power Current Distortion, S	Quality, Definition – Importance of Power Quality, Voltage Q ources of Power Quality Problems, Economic impacts	uality, Voltage Versus									
UNIT II	POWER QUALITY PHENOMENA	9									
Categories of Power Variations, Sags, Sv Fluctuations, Flicker,	Quality: Transients, Steady State Variations, Short Duration and vells, Interruptions, Voltage Unbalance, Waveform Distortion Power Frequency Variation. Causes, Effects and Solutions	Long Duration Voltage , Harmonics, Voltage									
UNIT III	STANDARDS AND CHARTS	9									
Need and Role of PQ standards, Indian Standards, International Power Quality Standards and Charts: IEEE standards, IEC Standards, Total harmonics distortion (THD), Power acceptability curves: Computer Business Equipment Manufacturers Association (CBEMA) curve, Semiconductor Equipment and Materials International group (SEMI) curve, Information Technology Industry Council (ITIC) curve.											
UNIT IV	LINEAR AND NON LINEAR LOADS	9									
Fluorescent lighting, Fans, Computer Loads, Switch Mode Power Supplies (SMPS), Uninterrupted Power Supply (UPS), Electronic Ballasts, microprocessor based control systems (PCs, PLCs), Inverters, Battery load, Battery Chargers, Biomedical devices, Network devices											
UNIT V	CASE STUDY	9									
Simulation of Powe transforms for PQ ar of proper wiring and	r Quality Problems using PQ teaching toy software. Introduc nalysis, Overview of Power Conditioning Devices and Mitigating Ec grounding. Outline of Power Quality Monitoring Systems.	tion to Mathematical quipments. Importance									
		TOTAL: 45 PERIODS									
TEXTBOOKS:											
 Roger C. Dug Quality', Mct Math H.J.Bo Press,2000 	gan, Mark F. McGranaghan, Surya Santoso and H.WayneBeaty, 'Ele Graw Hill, 2003. ollen, 'Understanding Power Quality Problems-Voltage Sag &	ectrical Power Systems Interruptions', IEEE									
REFERENCE BOOKS:											
1. G.T. Heydt, '	Electric Power Quality', 2 nd Edition. Circle Publications, 1994.										
2. Arrillaga, N.F	R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 19	99.									
EXTENSIVE READING:											
 Electric Power Quality by <u>Surajit Chattopadhyay</u> (http://www.springer.com/engineering/energy+technology/book/978-94-007-0634-7) Power Quality by<u>C. Sankaran</u> (www.fer.unizg.hr/_download/repository/Power_Quality.pdf) Power Quality in Electrical Systems by<u>Alexander Kusko, Marc T. Thompson</u> (http://www.lybrary.com/power-quality-in-electrical-systems-p-56147.html) 											

COL	URSE C	ODE:				COL	JRSE TI	ΓLE:				L	Т	Р	С
10)213EE	108				LED	LIGHTI	NG				3	0	0	3
COURS	E CATE	GORY:	Open E	lective											
PREAN discuss lighting based develop	PREAMBLE: This course forms the basis for understanding the types and fabrication of LEDs also it aims to discuss about the significance of driver circuits used in LED lighting system. The control strategies used in lighting of LED based systems are discussed so as to provide knowledge in design and analysis of LED based system. Lastly, the course also provides basic hands on exposure on assembly techniques for developing LED based products.														
PREREC	QUISIT	E COUR	SES: Ni												
COURS The ob	 COURSE EDUCATIONAL OBJECTIVES: The objectives of the course are to make the students, State the need for Illumination List standard voltage levels. Power electronics as applied to LED technology Define the aspects of design of lighting systems Maintain the lighting systems Fault rectification of lighting systems 														
			ition of	lignting	g syster	ns									
COURSE OUTCOMES : Upon the successful completion of the course, students will be able to:															
CO Nos	5.				Course	Outco	mes				Know on	/leda rev Ta	ge Le vised xonc	evel (B Bloom omy)	ased 1's
CO:	1 E il	xplain t Iuminat	he func ion anc	lament l optica	al elem I desigr	ents, la า	iws and	quanti	ties of				K2		
CO	2 E	xplain a	bout Ll	ED light	ing, typ	es of li	ghtings						K2		
CO	3 C c)iscuss a ircuits u	ind des ised in l	ign the LED tec	types a hnolog	ınd wor y	rking of	power	electro	onic			К3		
CO4	4 C s	evelop ystems	the Lig and ap	hting co olicatio	ontrol s [.] ns	trategie	es, build	ding ligl	nting co	ontrol			К3		
CO!	5 C n	esign a nainten	nd fabr ance of	icate P(LED sy:	CB for L stems	ED ligh	ting sys	item, re	epair,				К3		
CORRE	LATION	N OF CO	s WITH	POs A	ND PSC)s									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	РО	12	PSO1	PSO2
CO1	М		Н					М							
CO2		м				М									
CO3	н		М					М		м					
CO4					М										
CO5															

COURSE CONTENT:											
UNIT I	LIGHT AND ILLUMINATION	9									
Basics about Light: Electromagnetic Spectrum, Visible Spectrum, Wavelength, Characterisations, Classification of Radiometry & Photometry - Natural & Artificial Light Sources - Characteristics about Light - Light and Vision - Evolution of Lighting Technologies - Merits and Demerits of the technologies - Instruments used for Measurement of Light Quantities.											
UNIT II	LED TECHNOLOGY	9									
Physics of a LED - Electrical characteristics - Optical characteristics - Data Sheet interpretation - Types of LED's - Experimental Procedures for determination of the Characteristics - White LED Parameters - Solid State Luminaire - Solid State Luminaire Standards - Performance Measurements											
UNIT III	POWER ELECTRONICS FOR LED LIGHTING	9									
LED Driver Requirements and Regional Standards – Topology Overview - Linear, Buck, Boost, Buck-Boost, Sepic& Fly-back) - Driving options - Discrete based drivers, Linear drivers, Switching drivers - AC-DC Drivers, Importance of Power Factor Correction (PFC), Single Stage vs 2-Stage Design, TRIAC Dimmable AC- DC Drivers - PWM IC											
UNIT IV	LIGHT POWER & CONTROL	9									
algorithn lighting o multi-cha systems; monitori	Lighting control strategies, techniques & equipment, sensors and timers, switches versus dimming control algorithm, harmonics, El from lighting equipment – its measurement & suppression techniques. Impact of lighting control, protocols for lighting control; Lighting control by computer, simple multi-channel & large multi-channel control, stage & entertainment lighting control, architectural & building lighting control systems; Centralised vs. distributed system; Status monitoring, fault monitoring, electrical load monitoring, lamp life monitoring system, applications										
UNIT V	LED MANUFACTURING TECHNOLOGY	9									
Design F printing, & Repair ADVANC	undamentals of LED Lamps - Testing Of LED Lamps – SMD PCB Assembly te Pick & place Machines programming & practice, Reflow soldering, Hand So , Dispensing, Coating, protection Optional ED: LED Packaging process- Diebonding, Wire bonding, Encapsulation etc.	chnology – Screen oldering, SMD REWORK									
		TOTAL: 45 PERIODS									
TEXTBO	DKS:										
 Amar K.Ganguly 'Optoelectronic Devices and Circuits, Theory and Applications', Narosa Publishing House. Dr.P.S.Bimbhra 'Power Electronics', Khanna Publishers. 											
REFERENCE BOOKS:											
 LIGHT-EMITTING DIODES E. FRED SCHUBERT , Cambridge University Press The Edinburgh Building, Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore. Anil Valia 'Light Design', Published by Mili Jain. 											

COURSE CODE:	COURSE TITLE:	L	т	Р	С
10213EE109	TRANSDUCERS AND SENSORS	3	0	0	3

COURSE CATEGORY: Open Elective

PREAMBLE: To enable the students to select and design suitable instruments to meet the requirements of industrial; application and various transducers, sensors used for the measurements of various physical quantities.

PREREQUISITES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

To impart knowledge on

- To understand the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities.
- To explain the principles of operation of the sensor parameters
- To understand the knowledge about the implementation of sensors and transducers into a control system structure.

COURSE OUTCOMES:

Upon the completion of the course students will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Classify and describe various transducers which are used for measuring various parameter like displacement, temperature etc.	К2
CO2	Understand the static and dynamics characteristics of transducers	К2
CO3	Identify the type of transducers used for various application	К2
CO4	Understand the virtual instrumentation for various data acquisition	К2
CO5	Understand the types sensor used for various applications	К2

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Н	М	н	Н	L						L			
Μ	L	Н	М	L						L			
Н	L	н	М	L						М			L
Н	L	н	М	L						М			
Н	н	н	М	М						Н			L
	P01 H M H H	PO1 PO2 H M M L H L H L H L H L	PO2 PO3 H M H M L H H L H H L H H L H H L H H L H H L H	PO1 PO2 PO3 PO4 H M H H M L H M H L H M H L H M H L H M H L H M H L H M	PO1 PO2 PO3 PO4 PO5 H M H H L M L H M L M L H M L H L H M L H L H M L H L H M L H L H M L H L H M L	PO1 PO3 PO4 PO5 PO6 H M H H L I M L H M L I M L H M L I M L H M L I H L H M L I H L H M L I H L H M L I	PO1PO2PO3PO4PO5PO6PO7HMHIIIMIMIIIHIMIIIHIMIIIHIMIIIHHMIII	PO1PO2PO3PO4PO5PO6PO7PO8HMHLLIIMLMLIIIHLHMLIIHLHMLIIHHMLIIHHMIII	PO1PO2PO3PO4PO5PO6PO7PO8PO9HMHLLIIIMLMLIIIIHLHMLIIIHLHMLIIIHHMIIIIIHHMMIIII	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10HMHLLIIIMLMLIIIIHLMLIIIIHLHMLIIIHHMIIIIIHHMMIIII	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11HMHI.I.I.I.I.I.I.I.MI.MI.I.I.I.I.I.I.I.HI.MI.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI.I.I.I	PO1PO3PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12HMHI.I.I.I.I.I.I.I.I.MI.MI.I.I.I.I.I.I.I.I.HI.MI.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI.I.I.I.I.I.I.I.I.I.HI. <t< td=""><td>PO1PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01HMHLIIIIIIIIIMLHMIIIIIIIIIHLHMIIIIIIIIIHIHIIIIIIIIIIHHIIIIIIIIIIIHIIIIIIIIIIIIHIII</td></t<>	PO1PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01HMHLIIIIIIIIIMLHMIIIIIIIIIHLHMIIIIIIIIIHIHIIIIIIIIIIHHIIIIIIIIIIIHIIIIIIIIIIIIHIII

COURSE CONTENTS								
UNIT I	INTRODUCTION	9						
Basic method of mea errors, classification transducers, basic rec	asurement, generalized scheme for measurement systems, of errors, error analysis, statistical methods, sensor, transd quirement of transducers.	, units and standards, ucer , classification of						
UNIT II	CHARACTERISTICS OF TRANSDUCERS	9						
Static characteristics, second order transdu	dynamic characteristics, mathematical model of transduce cers – response to step, ramp and sinusoidal inputs.	r, zero, first order and						
UNIT III RESISTIVE, INDUCTIVE AND CAPACITANCE 9 TRANSDUCERS								
Potentiometer, Strair transducer, Capacitor effect transducer, fibe	n gauge, LVDT, variable reluctance transducers, Proximity t microphone, capacitive thickness Transducers, capacitive s er optic transducer and its application.	ransducers, capacitive train transducers, hall						
UNIT IV	DATA ACQUISITION	9						
Types of transducer, software architecture based measurement	signals, signal conditioning, DAQ hardware, analog inpute, selection and configuration data acquisition device, com system	its and outputs, DAQ aponents of computer						
UNIT V	SENSORS	9						
Introduction to senso Ultrasonic Sensors, Th	rs, types of sensor, smart sensors, fiber optic sensors, MEMS nin Film Sensors, Liquid Level Sensors, typical application of s	5, nano sensors, sensors						
		TOTAL: 45 PERIODS						
TEXTBOOKS:								
1. Sawhney. A.K, Edition, Dhan	, 'A Course in Electrical and Electronics Measurements and pat Rai & Company Private Limited, 2007.	Instrumentation', 18 th						
2. Renganathan.	S, 'Transducer Engineering', Allied Publishers, Chennai, 2003	3.						
REFERENCE BOOKS:								
1. Murthy.D.V.S	, 'Transducers and Instrumentation', Prentice Hall of India, 20	001						
2. Doebelin. E.A 2000.	, 'Measurement Systems – Applications and Desig', Tata M	cGraw Hill, New York,						
3. Patranabis. D	, 'Sensors and Transducers', Prentice Hall of India, 1999.							
4. John. P, Bentl	ey, 'Principles of Measurement Systems', III Edition, Pearsor	Education, 2000.						
5. Doebelin. E.A 2000.	, 'Measurement Systems – Applications and Design', Tata N	1cGraw Hill, New York,						

COURSE CODE:	COURSE TITLE:	L	Т	Р	С					
10213EE110	SIGNALS AND SYSTEMS	3	0	0	3					
COURSE CATEGORY: Open Elective										

PREAMBLE: This course becomes the basis of introducing the students to the concept of signals, systems and its types, also the method of handling the signals by various mathematical tools. This course is designed pedagogically and uncovers the concepts of continuous and discrete time signals and the systems.

PREREQUISITE COURSES: Engineering Mathematics

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- Introduce signals (Continuous and discrete), systems (Continuous and discrete), its types and operation on signals.
- Provide an intuitive understanding of the application of Fourier Series, Fourier Transforms (Including DFT) and Z-transforms.
- Show the applications of these mathematical tools in networks.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Classify the various types of signal and systems and operate on the signals(like shifting ,scaling etc)	К2
CO2	Apply Fourier series and Fourier transforms in the analysis of signals	КЗ
CO3	Identify the significance of Laplace Transforms and apply the same to some basic circuits	К3
CO4	Understand the concept of sampling	К2
CO5	Apply the Z-Transforms technique to DT signal	К2

(CORRELATION OF COs WITH POS AND PSOs														
	COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	Н													
	CO2	Н							Н		М	Н			
	CO3	Н			Н				Н		М	Н			
	CO4		М	М	L		М		М		М				
	CO5										Н				

COURSE CONTENT:							
UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9					
Introduction Classificatio systems and	Introduction to Continuous and Discrete Time Signals- Continuous to Discrete transformation- sampling- Classifications of Continuous and Discrete time signal-Introduction to Continuous and Discrete Time systems and its Classification- LTI System- Impulse response						
UNIT II	FOURIER SERIES ANALYSIS	9					
Introduction Conditions -	n to Fourier Series-Trigonometric Coefficients- Evaluation of Fourier - Discrete time Fourier Series-Application of Fourier Series to netwo	Coeffificients-Symmetry orks					
UNIT III	FOURIER TRANSFORMS	9					
Representat Transforms- Transform P	Representation of Aperiodic signals- Continuous time Fourier Transform-Proper ties of Fourier Transforms-Discrete Time Fourier Transforms¬-Properties of DTFT-Duality- Fourier Series and Transform Pairs						
UNIT IV	LAPLACE TRANSFORMS	9					
Fourier to L Laplace Trar	aplace and Motivation-Region of Convergence - Properties of Lap nsforms- Application to Circuits	place transforms-Inverse					
UNIT V	Z- TRANSFORMS	9					
Introductior Z-transform	n-Region of Convergence- Relation Between s and z Plane- Z-transfers s to Discrete time systems-	orm Pairs- Application of					
		TOTAL: 45 PERIODS					
TEXTBOOKS	:						
1. 1. E 2. Alla	 B. P. Lathi, 'Principles of Linear Systems and Signals', 2nd Edition, Oxford, 2009. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, 'Signals and Systems', Pearson, 2007. 						
REFERENCE	BOOKS:						
1. R.E. Pea	1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, 'Signals & Systems - Continuous and Discrete', Pearson, 2007.						
2. Johi	n Alan Stuller, 'An Introduction to Signals and Systems', Thomson, 20	007.					
3. M.J. Hill,	Roberts, 'Signals & Systems Analysis using Transform Methods & 2007.	MATLAB', Tata McGraw					

COUR	SE CODE:	L	Т	Р	С					
1021	L3EE111	3	0	0	3					
COURSE CATEGORY: Open Elective										
PREAMBLE: Wearable Electronics mainly deals with the fundamentals of electronics and their applications in textiles and clothing product development										
PREREQU	PREREQUISITE COURSES: Basic Electrical Engineering									
COURSE E	DUCATIONAL	OBJECTIVES :								
• To	o learn about v	vearable technology and different interfacing techno	ologies.							
• To	 To understand about electro statically generated nano fibres. 									
• To	o describe abo	ut sensing fabric and understand smart fabric for he	alth care	etc.						
• To	o discuss strain	sensor in wearable devices.								
• To	o study the diff	erent applications of wearable technologies.								
COURSE C	DUTCOMES :									
Upon	the successful	completion of the course, students will be able to:								
CO Nos.		Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)							
CO1	Know the con interfacing m	ncept of wearable technology and different nethodologies	K2							
CO2	Discuss abou	t production of Nano fibres	К2							
CO3	Understand about sensing fabric, actuating fabrics etc. K2									

000		
CO4	Discuss about strain sensors used in wearable devices	К2
CO5	Understand about application of wearable technology in different fields	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н				L						L			
CO2	L	Н	L	Н	Н	Н	Н				L			
CO3	Н		Н					М	L	М				
CO4	L							М	М	М				
CO5	L		М		М			Н	М	М				

COURSE CON	COURSE CONTENT:							
UNIT I	INTRODUCTION	9						
Introduction- Technologies- Implications	Introduction-Current and Future Wearable technology -Interfacing Technologies-Communication Technologies-Data Management Technologies-Energy Management Technologies-Applications Implications							
UNIT II	ELECTROSTATICALLY GENERATED NANOFIBRES 9							
Introduction-I yarns and Nanocomposi	Introduction-Electro spinning process-Background-Controlling the diameter of the fibre-Formation of yarns and fabrics-Electro active nanofibers - Inherently conductive polymers and blends-Nanocomposites-Pyrolysis and coating of nanofibres							
UNIT III	ELECTROACTIVE FABRICS AND WEARABLE MAN- MACHINEINTERFACES	9						
Introduction- capture- Smar	Sensing Fabrics – Actuating fabrics- Smart Fabrics for Health care- Sn rt textiles for kinesthetic interfaces.	nart Fabric for motion						
UNIT IV	STRAIN SENSORS IN WEARABLE DEVICES	9						
Introduction- Applications of	Textile Based Strain Sensors for Wearable Devices-Fabrication of T of Textile Based Strain Sensors	extile Based Sensors-						
UNITV	APPLICATIONS	9						
Soldiers Statu fabric display-	us Monitoring Software - Design and Development of Flexible Sola Communication apparel, Protection and Safety aspects of using elect	ar Tent -Optical fibre ronic gadgets.						
	т	OTAL: 45 PERIODS						
TEXTBOOKS:								
1. Xiaom	ning Tao, 'Wearable Electronics and Photonics', CRC Press, 2005							
2. Subha Intern	 Subhas C. Mukhopadhyay, 'Wearable Electronics Sensors: For Safe and Healthy Living', Springer International Publishing, 2015 							

СС	DURSE	CODE:				COU	IRSE TI	LE:			L T P			C
1	0213E	E112				EMBED	DED S	YSTEM			3	0	0	3
COURS	COURSE CATEGORY: Open Elective													
PREAM charact studen	PREAMBLE: This Course aims to enable the students to gain a fair knowledge on concepts, characteristics and applications of embedded systems to Electrical Engineering and also it will make the students familiarize with real-time.													
PREREC	PREREQUISITE COURSES: Nil													
COURS	COURSE EDUCATIONAL OBJECTIVES:													
The ob	jective	s of the	course	e are to	make	the stu	dents,							
•	To tea hardv	ach stuo vare an	dents a d embe	ll aspeo edded s	cts of th oftwar	ne desi e deve	gn and Iopmer	develo nt.	pment	of an e	mbedd	ed syst	em, inc	luding
•	To lea	arn and	unders	stand th	ne char	acteris	tics of e	embedo	ded sys	tems a	nd its a	rchitec	tures.	
•	Unde	rstandii	ng and	experie	ence of	state c	of – the	- pract	ice ind	ustrial e	embed	ded sys	tems a	nd
•	To un	derstar	nd the c	operati	on of re	elopine eal time	e syster	ns.						
		CUWES	•	- 10 - 1 - 1 - 1 - 1			, , , , , , , , , , , , , , , , , ,							
Up	on the	succes	• sful cor	npletio	n of th	e cours	e, stud	ents wi	ill be at	ole to:				
				•			,				1	Knowle	dge Le	vel
Nos					Cours	e Outco	omes				(Based	on revi	sed
			امم مامل							f . i i	BI	oom's	Taxono	omy)
CO1	E E F	nbedde	ne det ed Svste	em.	s, com	ponent	s and	require	ements	of th	e		К2	
CO2	D	escribe	, the pro	ocessor	, archit	ecture	and m	emory	organis	ation c	of		К2	
	D	evelop	the int	terfacir	ng and	comm	unicati	on tecl	nnique	s of th	e			
CO3	Er	nbedde	ed Syste	em.					•				КЗ	
CO4	E> Sy	vplain vstem.	the I/C	D, test	ing an	d appl	ication	s of t	he Err	bedde	d		К2	
CO5	Di Sy	escribe vstems.	the de	efinitio	ns, cha	racteris	stics ar	nd issue	es of r	eal tim	e		K2	
CORRE	LATIO	N OF CC	Ds WITH	I POs A	AND PS	Os								
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	М	М	Μ	Н	М			Н	L	М	М	L		
CO2	М	М	М	Н	М			Н	L	М	М	L		
CO3	М	L	L	Н	М			Н		М	М			
CO4	М	М	М	Н	М			Н	L	М	М	M L M M		
CO5	М	М	М	Н	М			Н	L	М	М	L	М	М

COURSE CONTENT:								
UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	9						
Introduction and Processo	Introduction to Embedded Systems - definitions and constraints; Structures - Components - Hardware and Processor Requirements - Device and Device drivers - Examples of embedded systems.							
UNIT II	EMBEDDED PROCESSORS & MEMORY9							
Special Purp DSP Archited	Special Purpose Processors - General Purpose Processors - Architectural Issues: ARM, PIC, CISC, RISC, DSP Architectures - Memory - Memory Organization.							
UNIT III	EMBEDDED INTERFACING & COMMUNICATION	9						
Memory Int Parallel Dat Communicat	Memory Interfacing - Bus, Protocols & ISA Bus Interfacing - USB Interfacing - AD/DA interfacing - Parallel Data Communication - Serial Data Communication - Network Communication - Wireless Communication.							
UNIT IV	EMBEDDED SYSTEM I/O, TESTING & APPLICATION	9						
Timer – Interrupts – DMA – USB & IrDA - Testing - BIST - Open-loop and Closed Loop Control Systems - Application Examples: Washing Machine, Automotive Systems, Auto-focusing digital camera, Air-conditioner, Elevator Control System, ATM System.								
UNIT V	REAL TIME EMBEDDED SYSTEM	9						
Introduction Structure ar algorithms -	 Definition & characteristics of real-time systems - Issues nd performance measures of a real time system - Classical Uniprocessor scheduling of IRIS tasks - Mode changes - Fault tole 	in real time computing - Uniprocessor scheduling rrant scheduling.						
		TOTAL: 45 PERIODS						
TEXT BOOKS	:							
1. Raj k	Kamal, 'Embedded Systems', Tata McGraw Hill, 1 st Edition, 2004.							
2. Davi	d Simon, 'An Embedded Software Primer', Addison Wesley, 2000							
REFERENCE	BOOKS:							
1. R. M	all, 'Real Time Systems Theory and Practice', Pearson, 2008.							
2. Jean	J.Labrosse, 'Embedded System Building Blocks', CMP books, 2 nd	Edition, 1999.						
3. T. No Prog	pergaard, 'Embedded Systems Architecture: A Comprehensive Gu rammers', Newness, 2005.	uide for Engineers and						
4. Dr. F	Prasad, 'Embedded Real Time System', Wiley Dreamtech, 2004.							
L								

COURSE CODE:	COURSE TITLE:		Т	Р					
10213EE113	3	0	0						
COURSE CATEGORY: Open Elective									
DECAMPLE. To understand the methods/precedure of estimating tendering/ contracting are des									

PREAMBLE: To understand the methods/procedure of estimating, tendering/ contracting are desired. Knowledge of IE rules for different types of electrical Installation, their planning considerations equips the students with the capability to plan and prepare different Installation projects.

PREREQUISITE COURSES: Basic Electrical and Electronics Engineering.

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To learn the symbolic representation of the wiring materials.
- To learn quantity and cost of the material for IE Act.
- To teach specifications of electrical wiring.
- To understand about the different types of wrings
- To understand quantity and cost of the material for a electrical projects.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Explain the symbolic representation of the wiring materials.	К3
C02	Explain, estimate of quantity and cost of the material for the following IE Act.	К2
C03	Describe about the specifications of electrical wiring	K1
C04	Explain about the different types of wrings	К2
C05	Describe the quantity and cost of the material for a electrical project following IE Act.	K1

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		Н		М			Н			М			
CO2			L		L			Н			L			
CO3	М		М	L										
CO4			Н		L			L						
CO5	М		М	Н							Н			

С

COURSE CONTENT:										
UNIT I	ELECTRICAL SYMBOLS	9								
Main fuse boa board with sw and power. Ju Socket outlet 5 15 amps.	ard with switches (lighting) -Distribution fuse-board with switche itches (power) -Distribution fuse-board with switches (power) - N nction of conductors-Line Existing - Line Proposed - OH line UG cab amps - Socket outlet with switch 5 amps Socket outlet 15 amps - S	es (lighting) -Main fuse- lain witches for Lighting ble – Fault Line crossing - Gocket outlet with switch								
UNIT II	INDIAN ELECTRICITY RULES	9								
Rule 28 Voltage, Rule 30 Service Lines and apparatus on consumer premises, Rule 31 Cut-out on consumer's premises, Rule 46 Periodical inspections and testing of consumer's installation, Rule 47 Testing of consumer's installation.										
UNIT III	SPECIFICATION OF ELECTRICAL ITEMS	9								
Switches - Main Switches - Sockets - Switch boards - Wall socket - Fuse units - Lamp Holders - Ceiling rose - Distribution boxes - Miniature Circuit Breaker - Earth Leakage Circuit Breaker - Ceiling fan - Electronic fan regulator - Storage type Water Heater – Immersion Heater – Wires and Cables (PVC, VIR, Weather Proof) - UG Cable (LT and HT) - Copper conductor sizes and rating – Earth wires. Lamps: Incandescent lamp, fluorescent lamp, Sodium vapour lamp, High Pressure Mercury Vapour lamp, Halogen lamp - Neon tube/lamp										
UNIT IV	SYSTEMS OF INTERNAL WIRING, WIRE SIZE, FUSE, SHOCK, EARTHING, AND TESTING OF INSTALLATION	9								
back systems back system a sub-distributio Domestic insta electrical appli between circu Electric shock electric shock electricity.	nd Joint box system and tree system – Position of switches, cuto n boards. Considerations for selecting wire size – size of conc allation, Service connection, Distributors - Power rating of some ances Materials used as fuse element – Selection of fuse wire - typ it breaker and fuse – why fuse is not used in the neutral – table – Effects of electric shock – factors influencing the electric shoc – cure of shock - Treatment for electric shock - artificial respirati	g -comparison – Looping buts, main switch board, ductors /cable used for e important households pes of fuses – difference e for sizes of fuse wire. ck - Precautions against on - fire hazards due to								
UNIT V	DOMESTIC, COMMERCIAL AND INDUSTRIAL INSTALLATION ESTIMATES	9								
Conditions and in preparing el of material red machines, Scho scheme of a pa	Conditions and Requirements for Domestic, Commercial and Industrial Installation – steps to be followed in preparing electrical estimate (domestic, industrial and agricultural installation), Estimate the quantity of material required for Residential single bed room Flat (1BHK).Industrial power wiring having 4 or 5 machines, School building having 3 class rooms, Primary Health Centre having minimum 6 rooms, Lighting scheme of a party hall having minimum 20 twin TL fittings.									
	TOTAL: 45 PERIODS									
TEXT BOOKS:										
1. Gupta	'Electrical Estimating and Costing' (PDF).									
2. Dr.S.L.	Uppal 'Electrical Wiring, Estimating & Costing' (PDF).									
	REFERENCE BOOKS:									
1. C.R.Da	rgon, 'Electrical Drawing & Estimating'.									
2. N.D.Na										

COL	JRSE CODE:				C	OURSE	TITLE:				L	Т	Р	С
10	213EE114			RE	NEWAE	BLE ENE	ERGY S	STEMS	5		3	0	0	3
COURSE C	COURSE CATEGORY: Open Elective													
PREAMBLE: This course focuses on the new renewable energy based electric energy generation technologies and their integration into the power grid. The principals of new energy based distributed generation technologies: solar, wind, and fuel cells.														
PREREQU	PREREQUISITE COURSES: Basic Electrical Engineering													
COURSE E	DUCATION	AL OBJ	ECTIVE	S:										
The objec	tives of the o	course	are to	make tł	ne stud	ents,								
• In	troduce abo	out the	renewa	able en	ergy so	urces li	ke wind	l, solar	and wa	ve ene	rgy.			
• In	npart knowle	edge al	bout th	e envir	onment	tal frier	ndly ene	ergy pro	oduction	n and c	onsum	ption.		
• E>	kplain about	energy	y-efficie	ent syst	ems an	d prod	ucts for	variou	s applic	ations.				
COURSE O	COURSE OUTCOMES :													
Upon	the successf	ful com	pletior	n of the	course	, stude	nts will	be able	e to:					
CO Nos.				Course	Outco	mes				Know on	owledge Level (Based on revised Bloom's Taxonomy)			
CO1	Explain al	bout R	enewał	ole Ene	rgy reso	ources a	and imp	ortanc	e.		K	2		
CO2	Outline tl	he proo	cess of	photov	oltaic p	ower g	enerati	on.			K	2		
CO3	Outline t sources.	the pro	ocess c	of powe	er gene	eration	using	wind e	energy		K	2		
CO4	Biomass	and bio	ogas pro	oductio	n techr	niques.					K	2		
CO5	Explain t energy, ti	the fu idal en	ndame ergy, N	ntals IHD and	and ap d fuel co	plicatio ells.	ons of	Geoth	ermal		К	2		
CORRELA	TION OF CO	s WITH	POs A	ND PSC)s									
COs P	01 PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PS	02
CO1										L	L	L		L

 COURSE CONTENT:

 UNIT I
 INTRODUCTION
 9

 World energy use-reserves of energy resources-energy cycle of the earth-environmental aspects of energy utilization-renewable energy resources and their importance.
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UNIT II	SOLAR ENERGY	9							
Basic concepts heat transport semi- conduct	s, solar thermal systems and solar ponds, solar thermal central system, thermal storage systems, photovoltaic energy conve ors, solar cell, batteries, satellite solar power systems.	l receiver systems, heliostats, rsion, solid - state principles,							
UNIT III	WIND ENERGY	9							
Principles of wind power, wind turbine operation, site characteristics, horizontal and vertical axis types, new developments, small and large machines, magnus effect, design principles of wind turbine, storage systems.									
UNIT IV	BIOMASS AND BIOGAS	9							
Concepts and systems, biomass production, energy plantation, short rotation species, forestry system, biomass resource agro forestry wastes, municipal solid wastes and agro processing industrial residues, environmental factors and biomass energy development, combustion, pyrolysis, gasification and liquefaction, modeling, appliances and latest development, bioconversion: biogas, fermentation and wet processes, chemicals from biomass and biotechnology.									
UNIT V	OTHER RENEWABLE ENERGY SOURCES	9							
Geothermal e applications. applications. technologies.	Geothermal energy, types, systems and application, Ocean thermal energy, types, systems and applications. Wave energy - types, systems and applications. Tidal energy - types, systems and applications. Magneto Hydrodynamic system (MHD). Fuel cells – types and applications, hydrogen technologies. Micro-hydel systems. Hybrid systems and applications.								
		TOTAL: 45 PERIODS							
TEXT BOOKS:									
1. Rai G I	D, 'Non-Conventional Sources of Energy', Khanna Publishers, 20	06							
2. Sukha McGra	tme S P and Nayak J K, 'Solar Energy - Principles of Thermal aw Hill, 2008.	Collection and Storage', Tata							
REFERENCE BO	DOKS:								
1. Kotha PHI Pv	ri P, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources t. Ltd., New Delhi, 2008.	and Emerging Technologies',							
2. Bent S	Bent Sorensen, 'Renewable Energy', Academic Press, 2004.								
3. Abbas Private	 Abbasi S A and NaseemaAbbasi, 'Renewable Energy Sources and their Environmental Impact', PHI Private Limited, 2001. 								
4. Wakil	4. Wakil M M H, 'Power Plant Technology', McGraw Hill, 1984.								

COURSE CODE: 10213EE115

COURSE TITLE: AUTOMOTIVE ELECTRICAL & ELECTRONICS SYSTEMS

L	Т	Ρ	С
З	0	0	3

COURSE CATEGORY: Open Elective

PREAMBLE: The course is aimed at imparting fundamental knowledge about the electrical layout and to understand the various sensors and related control system assembly within an automobile

PREREQUISITE COURSES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To introduce the basic layout of an automotive electrical system.
- To introduce about the Starting and Charging systems of a vehicle.
- To introduce about the Sensors and Actuators used in an Automobile.
- To introduce about the control systems within a vehicle.
- To introduce about the basic management system within a vehicle.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Emphasize the basic architecture of Automotive Electrical systems.	К1
C02	Troubleshoot the problems behind the drives employed in a vehicle.	К2
C03	Analyze the different sensor arrangements in a vehicle	К1
C04	Differentiate the various control strategies on a vehicle	К1
C05	Manage an engine and understand it's input parameters for the ECU.	К2

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Μ							L						
CO2								М			Н			
CO3						L								
CO4								М					М	
CO5						Н					Н		М	

COURSE CONTENT:									
UNIT I	INTRODUCTION TO AUTOMOTIVE ELECTRICAL SYSTEM	9							
Automotiv diagrams Diagnosis	re Electrical Layout, Automotive component operation, Electrical v and symbols On Board Diagnostics, Dash Board instruments, V and troubleshooting.	wiring terminals, Circuit Narning Systems, Fault							
UNIT II	STARTING & CHARGING SYSTEMS	9							
Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motors& driving mechanism, D.C. Generator and Alternator-Maintenance of Drives- Regulation for Charging, lighting lamps and Fuses.									
UNIT III	AUTOMOTIVE SENSORS	9							
Introduction, Basic Sensor Arrangement, Types of sensors, Oxygen Sensor, Cranking Sensor, Position Sensor, Engine cooling water Sensor, engine oil pressure sensor, Flow sensor, Temperature and humidity sensor, Speed and Acceleration sensor, Knock sensor, Torque sensor, Yaw rate sensors.									
UNIT IV	AUTOMOTIVE CONTROL SYSTEMS	9							
Automotiv System, Bi System, St	Automotive microcontrollers, Engine Control Systems, Transmission Control System, Cruise Control System, Braking Control System, Traction Control System, Stability Control System, Suspension Control System, Steering Control System.								
UNIT V	ENGINE MANAGEMENT SYSTEM	9							
Engine-Construction & stroke Classification-Sensor arrangements in Engine, Open & Closed loop Control, engine cooling and warm up control, acceleration, detonation and idle speed control, exhaust									
emission c	ngine cooling and warm up control, acceleration, detonation and idle control engineering.	e speed control, exhaust							
emission c	ngine cooling and warm up control, acceleration, detonation and idle control engineering.	TOTAL: 45 PERIODS							
emission c	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS:	TOTAL: 45 PERIODS							
TEXT BOO	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotiv 12.	TOTAL: 45 PERIODS							
TEXT BOO 1. W 20 2. P	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotiv 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Educatior	TOTAL: 45 PERIODS ve Electronics', Elsevier, n, 2004.							
TEXT BOO 1. W 20 2. P	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotiv 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education E BOOKS:	TOTAL: 45 PERIODS ve Electronics', Elsevier, n, 2004.							
TEXT BOO 1. W 20 2. P REFERENC 1. TC	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotive 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education E BOOKS: om Denton 'Automobile Electrical and Electronics Systems', Elsevier, 4	TOTAL: 45 PERIODS ve Electronics', Elsevier, n, 2004. t th Edition (April 9, 2012)							
TEXT BOO 1. W 20 2. P REFERENC 1. To 2. Ro	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotive 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education E BOOKS: om Denton 'Automobile Electrical and Electronics Systems', Elsevier, 4 obert Bosch 'Automotive Handbook' SAE- 2011 Edition I.	TOTAL: 45 PERIODS ve Electronics', Elsevier, h, 2004. t th Edition (April 9, 2012)							
TEXT BOO 1. W 20 2. P REFERENC 1. To 2. Ro 3. Dr	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotive 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education E BOOKS: om Denton 'Automobile Electrical and Electronics Systems', Elsevier, 4 obert Bosch 'Automotive Handbook' SAE- 2011 Edition I. Kirpal Singh 'Automobile Engineering', Standard Publishers, Vol- 1 ar	TOTAL: 45 PERIODS ve Electronics', Elsevier, h, 2004. t th Edition (April 9, 2012) hd Vol- 2, 2012.							
TEXT BOO 1. W 20 2. P REFERENC 1. TC 2. RC 3. Dr 4. Ju	ngine cooling and warm up control, acceleration, detonation and idle control engineering. KS: illiam B. Ribbens, Norman P. Mansour 'Understanding Automotive 12. L Kohli 'Automotive Electrical Equipment' Tata McGraw-Hill Education E BOOKS: om Denton 'Automobile Electrical and Electronics Systems', Elsevier, 4 obert Bosch 'Automotive Handbook' SAE- 2011 Edition I. :Kirpal Singh 'Automobile Engineering', Standard Publishers, Vol- 1 ar dge A.W. 'Modern Electrical Equipment of Automobiles' Chapman an	TOTAL: 45 PERIODS TOTAL: 45 PERIODS Ve Electronics', Elsevier, n, 2004. t th Edition (April 9, 2012) nd Vol- 2, 2012. d Hall, London, 2011.							

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE116	HYBRID ELECTRIC VEHICLES	3	0	0	3

COURSE CATEGORY: Open Elective

PREAMBLE: This course aims in providing the fundamental knowledge on electric and hybrid power trains, introduction to the principle of regenerative braking and environmental advantages of electric & hybrid vehicles.

PREREQUISITE COURSES: Basic Electrical Engineering, Basic Electronics Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- An overview of the vehicle propulsion principle.
- An understanding of the electric vehicles and its powertrains.
- The fundamental knowledge on hybrid electric vehicles.
- An elaborate knowledge on regenerative braking.
- Broad analytical knowledge on advantages of electric vehicles on environment.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Enumerate the principle of vehicle propulsion and braking	К1
C02	Demonstrate the structure of an electric vehicle	К2
C03	Illustrate the working principle of a Hybrid Electric Vehicle	К2
C04	Identify and solve the problems in regenerative braking	К2
C05	Articulate the effects of electric and hybrid vehicles on environment	К2

CORRELATION OF COS WITH POS AND PSOS

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						L								
CO2								Н						
CO3								Н						
CO4			М			М								
CO5										Н			L	М

COURSE CONTENT:

UNIT I FUNDAMENTALS OF VEHICLE PROPULSION

General Description of Vehicle Movement- Vehicle Resistance- Dynamic Equation- Power Train Tractive Effort and Vehicle Speed- Vehicle Power Plant and Transmission Characteristics- Vehicle Performance-Operating Fuel Economy- Brake Performance

UNIT II	ELECTRIC VEHICLE& PROPULSION SYSTEMS	9									
Configurations Transmission Consumption- Permanent Ma	of EVs- Performance of EVs- Traction Motor Charact Requirement- Vehicle Performance- Tractive Effort i Principle of Operation and Performance-DC Motor Dri gnet BLDC Motor Drives-SRM Drives	eristics- Tractive Effort and n Normal Driving- Energy ves-Induction Motor Drives-									
UNIT III	HYBRID ELECTRIC VEHICLES	9									
HEV-Types of HEVs-Series & Parallel HEVs-Advantages & Disadvantages-Series-Parallel Combination- Design of an HEV-Hybrid Drivetrains-sizing of components-rated vehicle velocity											
UNIT IV	REGENERATIVE BRAKING	9									
Braking Energ versus Brakin Deceleration R Hybrid Braking	Braking Energy Consumed in Urban Driving- Braking Energy versus Vehicle Speed- Braking Energy versus Braking Power- Braking Energy versus Braking Power- Braking Energy versus Vehicle Deceleration Rate- Braking Energy on Front and Rear Axles- Brake System of EV, HEV, and FCV- Parallel Hybrid Braking System- Fully Controllable Hybrid Brake System										
UNIT V	ELECTRIC VEHICLES & ENVIRONMENT	9									
Vehicle Polluti Alternative an The Role of Re	on: the Effects- Vehicles Pollution: a Quantitative Analysis- d Sustainable Energy Used via the Grid- Using Sustainable gulations and Law Makers-Case study of rechargeable batter	Vehicle Pollution in Context- Energy with Fueled Vehicles- ry vehicles.									
		TOTAL: 45 PERIODS									
TEXT BOOKS:											
1. Husain 2. Larmir Ltd., 20	I 'Electric and Hybrid Vehicles: Design Fundamentals', CRC I ie, James, and John Lowry. 'Electric Vehicle Technology E 003.	Press; 2011. Explained', John Wiley&Sons,									
REFERENCE BC	OOKS:										
1. Ehsani Vehicle	, Mehrdad, YiminGao, and Ali Emadi 'Modern Electric, H es: Fundamentals, Theory, and Design', CRC Press, 2009.	lybrid Electric, and Fuel Cell									
2. Emadi,	Ali, 'Handbook of Automotive Power Electronics and Motor	Drives', CRC Press, 2005.									
3. Soylu,	Seref, 'Electric Vehicles: The Benefits and Barriers', InTech, 2	2011. Surana Dijaka Graatia 2011									
4. Soylu,	Seret. Electric Venicles—Iviodelling and Simulations' InTech	Europe, Rijeka, Croatia, 2011.									

С	OURSE	CODE:				COL	JRSE TI	TLE:			L	Т	Р	C								
10213EE117					INTRODUCTION TO ROBOTICS						3	0	0	3								
OURS	OURSE CATEGORY: Open Elective																					
REAN	1BLE: T	his cou	rse will	help tł	ne stud	ents to	study	the bas	ic conc	epts of	roboti	cs and	their de	esign.								
RERE	QUISIT	E COUF	RSES: N	il																		
OURS	E EDU		IAL OB.	JECTIVE	ES:																	
he ob	jective	s of the	course	e are to	make	the stu	dents,															
•	Robot applic	tics is th ation, a	ne engi and stru	neering uctural	g scienc disposi	e and t ition.	echnol	ogy of	robots,	, and th	eir des	ign, ma	nufact	ure,								
OURS		COMES	:																			
pon t	he suco	cessful	comple	tion of	the co	urse, st	udents	will be	able t	o:												
CO Nos.				Cou	rse Ou	tcomes	5			Kno rev	owledg ised Bl	ge Leve oom's	l (Base Taxono	d on omy)								
C01	Intr	oductio	on abou	ut basic	compo	onents	and typ	bes of r	obots			K1										
C02	Ana	lysis of	robot	motion	and co	ontrol						K2										
C03	Bas	ic conc	epts of	Artifici	al intel	ligence						K2										
	Deb	Dasic concepts of Artificial Intelligence K2																				
C04	ROD	Applications of robotics									К2											
C04 C05	Арр	licatio	ns of ro	botics							CU5 Applications of robotics K2											
C04 C05	Арр	bication	ns of ro	botics								KZ										
C04 C05 ORRE	App LATION	blication	ns of ro	botics H POs A	AND PS	Os						K2										
C04 C05 ORRE Cos		N OF CC	ns of ro Ds WITH PO3	botics H POs A PO4	AND PS PO5	Os PO6	P07	PO8	PO9	PO10	P011	K2 PO12	PSO1	PSO2								
C04 C05 ORRE Cos C01	App LATION PO1	N OF CC	ns of ro Ds WITH PO3	botics H POs A PO4	AND PS PO5	Os PO6 L	P07	РО8	PO9	PO10	PO11	PO12	PSO1	PSO								
C04 C05 ORRE Cos CO1 CO2 CO3	App LATION PO1	N OF CC	PO3	H POs A	AND PS PO5	Os PO6 L	PO7	РО8 Н Н	PO9	PO10	P011	P012	PSO1 M	PSO2								
C04 C05 ORRE Cos CO1 CO2 CO3 CO4	App LATION PO1	N OF CC	PO3	botics H POs A PO4	AND PS PO5	Os PO6 L M	P07	РО8 Н Н	PO9	PO10	P011	P012	PSO1 M	PSO								

Automation and robotics; Robot Anatomy; Classifications of Robots by DOF motion, platform, power source, intelligence and application area.

BASIC COMPONENS OF ROBOTS

INTRODUCTION

UNIT I

a) Manipulators; Wrists; End effectors; Control units; Power units; Robot sensors;

b) Robot sensors; Proximity sensors; Ranger sensors, Tactile sensors; Visual sensors; Sensors for mobile Robots.

UNIT II	ROBOT MOTION ANALYSIS AND CONTROL	9						
Introduction Manipulator p	Introduction to manipulator kinematics; Homogeneous transformations and Robot kinematic Manipulator path control; Robot dynamics; configuration of a Robot controller; Obstacle avoidance.							
UNIT III	JIT III ARTIFICIAL INTELLIGENCE 9							
AI –techniques – fuzzy logic, neural network ; LISP programming; AI and Robotics; LIPS in the factory; Sensing and digitizing function machine vision; Image processing and analysis; training and vision system; natural language processing; speech recognition; legged locomotion; collision avoidance; natural networks computing.								
UNIT IV	ROBOT PROGRAMMING	9						
Methods of Robot programming; lead through programming methods; a robot program as a path in space; motion interpolation; weight, signal and delay commands; Branching, capabilities and limitations of lead through methods.								
UNIT V	APPLICAIONS OF ROBOT	9						
Material hand	ling; Processing operations; Assembly and inspection; Future a	application.						
		TOTAL: 45 PERIODS						
TEXT BOOKS:								
1. Mikell techno	P.Groover, Michellwein,Roger N. Nagal and Nicholas G.C blogy, Programming and applications' Mc Graw Hill, 1987.	Ordey, 'Industrial Robotics,						
2. Harry 1989.	2. Harry H. Poole, 'Fundamentals of Robotics Engineering', Van Nostrand Reinhold, New York, 1989.							
REFERENCE BO	DOKS:							
1. V.Dam	nel Hunt, 'Smart Robots', Chappan and Hall, 1985							
2. P.G.Ra	anky, C.Y.Ho, 'Robot Modeling', IFS (publication) Ltd., UK, 1985							
3. Wenw Intern	3. Wenwar L. Hall, Bethe C. Hall, 'Robotics – A User Friendly Introduction", Holt – Saunders International Edition, Japan, 1985.							

COURSE CODE:
10213EE118

COURSE TITLE: STANDARDS, CALIBRATION, TESTING & MAINTENANCE OF ELECTRICAL EQUIPMENTS

L

3

COURSE CATEGORY: Open Elective

PREAMBLE: This course introduces the students about the electrical safety operations and IEEE standards.

PREREQUISITE COURSES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

- The objectives of the course are to make the students,
- To develop Calibration Professionals capable of handling calibration laboratories & managing calibration system in an organization
- Understand Measurement Units, Standards, Systems, Testing & Calibration, Traceability & Uncertainty, Mathematics & and Applied Statistics
- Understanding standards ISO 9001 & 17025 requirements with regard to Laboratory Management for implementation & maintenance of accreditation

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Measurement standards and its units	К2
CO2	Measurement methods and characteristics of measurements	К2
CO3	Calibration procedures and methods of calibration	К2
CO4	Basics of Statistics and applied mathematics	К2
CO5	To estimate uncertainty & reporting about uncertainty	К2

CORRELATION OF COS WITH POS AND PSOS

Cos	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			М					L	М			L		
CO2	L		М	М				L	М					
CO3			М	L				L	М					
CO4				L				L			М			
CO5	М			Н				L	М					
COURS	COURSE CONTENT:													
UNIT	UNIT I GENERAL METROLOGY 9													

Global metrology scenario, Measurement units, Measurement standards & Measurement traceability.

UNIT II	MEASUREMENT SYSTEM	9						
Measuren Primary er	Measurement methods, Measurement data & characteristics of measurements, T&ME specification Primary error sources, Measurement systems and capabilities & Measurement assurance programs							
UNIT III	CALIBRATION SYSTEM 9							
Calibration environme	Calibration procedures & methods, Industry practices & regulations, Control of calibration environment, Calibration processes, Manual & automated calibration, Calibration results &							
reporting	and Records & records management							
UNIT IV	V APPLIED MATHEMATICS & STATISTICS							
Technical	& Applied mathematics, QC tools and Applied statistics							
UNIT V	UNCERTAINTY	9						
Uncertain uncertaint	ty management, Uncertainty components, Estimation of unc y & Reporting uncertainty	ertainty, Evaluation of						
		TOTAL: 45 PERIODS						
REFERENC	E BOOKS:							
1. B. ^v	1. B.V.S Rao 'Operation and Maintenance of Electrical Equipment's' Media Promoters and Publishers, Volume1.							
 Alan S Morris 'Measurement and Instrumentation: Theory and Application' 2nd Edition, Elsevier, 2015. 								

COURS	E CODE:	L	Т	Р	С					
10213	EE119	3	0	0	3					
COURSE	COURSE CATEGORY: Open Elective									
PREAMBLE: This course introduces the Electrical safety operations and IEEE Standards.										
PREREQU	PREREQUISITE COURSES: Basic Electrical Engineering									
COURSE	COURSE EDUCATIONAL OBJECTIVES:									
The obje	ctives of th	e course are to make the students,								
• 9	tudy abou	t electrical safety and equipment required to maintain sat	fety.							
• [Details abo	ut Protection guidelines and importance of earthing.								
• 1	o get knov	vledge about Indian electricity rules and regulations and I	EEE star	ndards	for ele	ctrical				
	arety.	<u>,</u>								
Upor	ourcome the succe	:5: ssful completion of the course students will be able to:								
0 p 0 l			Knowle	dge Le	vel (Ba	ased				
Nos.		Course Outcomes	on re	evised Taxono	Bloom' my)	's				
CO1	Basics of	electrical safety		K2						
CO2	Protectio	on procedures and earthing requirements		K2						
CO3	CO3 Safety requirements while doing electrical works K2									
CO4	CO4 Safe operating procedures, energy auditing basics K2									
CO5	CO5 Regulations and standards related to electrical safety K2									
L	1									

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			М					L	М			L		
CO2	L		М	М				L	М					
CO3			М	L				L	М					
CO4				L				L			М			
CO5	М			Н				L	М					

COURSE CONTENT:

UNIT I ELECTRICAL SAFETY

Safety of the Self, Safety of the equipments, Safety of the public.

UNIT II	PROTECTION PROCEDURES AND EARTHING	9					
Guidelines, General guidelines on earthing and protection							
UNIT III	SAFETY OPERATIONS 9						
Sign board	Sign boards, Tagging system and procedures.						
UNIT IV	SAFE OPERATING PROCEDURES	9					
Safe opera	iting procedures, Case studies and, Audit basics.						
UNIT V REGULATIONS 9							
IS, IEEE standards, Indian Electricity rules and regulations							

TOTAL: 45 PERIODS

TEXT BOOKS:

- 1. HSC- A Practical Guide Vol. 1 To 4, National Safety Council, India.
- 2. IS 5216 (Part I)- 1982, 'Recommendations on Safety Procedures and Practices in Electric Work'.

REFERENCE BOOKS:

- 1. SP 30 -1985 Special Publication-National Electric Code, 'Section-14: Electric Aspects of Building Services'.
- 2. IEEE Standard 902.
- 3. Indian Electricity Rules: IE Rules1956.
- 4. Quality Control Order 2003: GO India Ministry of Commerce & Industry.
- 5. IS 8437: Guide on Current Through Human Body
- 6. Related technical papers of present interest.
- 7. Blake R P, Industrial Safety, Prentice, Englewood Cliffs ,1963

COURSE CODE:	
10213EE120	

COURSE TITLE:

ENERGY CONSERVATION AND MANAGEMENT

3	0	0	3
L	Т	Ρ	С

COURSE CATEGORY: Open Elective

PREAMBLE: This course gives a brief introduction about electrical energy conservation and mitigation.

PREREQUISITE COURSES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To understand the basics about energy engineering and management.
- To get knowledge about EB and efficient way to use electrical energy.
- Basics about thermal engineering and equipment related to thermal engineering.
- Quantity of electrical energy utilized by different components.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Introduction about energy consumption, energy management, energy auditing.	К2
CO2	Energy consumption and capacity of different electrical equipment's	К2
CO3	Thermal stability and analysis of electrical equipment's	К2
CO4	Energy conservation in major electrical devices	К2
CO5	Economical oriented energy management systems	К2

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			М					L	М			L		
CO2	L		М	М				L	М					
CO3			М	L				L	М					
CO4				L				L			М			
CO5	М			Н				L	М					

COURSE		Γ
UNIT I	INTRODUCTION	9
Energy Environ and Bar	 Power – Past & Present scenario of World; National Energ mental aspects associated with energy utilization –Energy Auditing: Nergin Role of Energy Managers. Instruments for energy auditing. 	y consumption Data eed, Types, Methodolog
UNIT I	ELECTRICAL SYSTEMS	9
Compor Factor Motors, Illumina	nents of EB billing – HT and LT supply, Transformers, Cable Sizing, Conc mprovement, Harmonics, Electric Motors – Motor Efficiency Comp Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting tion	ept of Capacitors, Powe utation, Energy Efficien g and scope of Encon i
UNIT II	THERMAL SYSTEMS	9
Stoichic measur Insulato	metry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency es. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, rs & Refractories	computation and enco Flash Steam Utilization
	ENERGY CONSERVATION IN MAJOR UTILITIES	9
Pumps, Towers	Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditi – D.G.	ioning Systems – Coolin
	ECONOMICS	9
Energy Cycle Co	Economics – Discount Rate, Payback Period, Internal Rate of Return, sting –ESCO concept	Net Present Value, Life
		TOTAL: 45 PERIODS
TEXT BO	OOKS:	
1.	Energy Manager Training Manual (4 Volumes) available at www.energy website administered by Bureau of Energy Efficiency (BEE), a statutor Power, Government of India, 2004.	ymanager training.com, a y body under Ministry o
2.	Witte. L.C., P.S. Schmidt, D.R. Brown, 'Industrial Energy Manag Hemisphere Publ, Washington, 1988.	gement and Utilisatior
REFERE	NCE BOOKS:	
1.	Callaghn, P.W. 'Design and Management for Energy Conservation', I 1981.	Pergamon Press, Oxforc
2.	Dryden. I.G.C., 'The Efficient Use of Energy' Butterworths, London, 198	2
	Turner. W.C., 'Energy Management Hand Book', Wiley, New York, 1982	2.
3.		

	COURSE CODE:	COURSE TITLE:		L	Т	Ρ	С
	10213EE121	ELECTRICAL MACHINES		3	0	0	3
COURSE	CATEGORY: Open Elective	2					
PREAMB methods	LE: In this course studer of speed controls, Applic	nt will get expose basic Electrical DC & ations as stepper & Brushless motors.	AC mac	hines	con	cepts	, and
PREREQU	JISITE COURSES: Basic Ele	ectrical Engineering					
COURSE	EDUCATIONAL OBJECTIV	ES:					
The obje	ctives of the course are to	make the students,					
• т	o provide knowledge on	construction and operation of DC machin	es.				
• T	o provide Theory and ope	eration, phase diagram of transformer.					
• T	o understand the Concep	t of synchronous machines.					
• T	o understand the poly ph	ase Induction motor principle.					
• T	o provide knowledge on	single phase Induction motor principle.					
COURSE	OUTCOMES :						
Upor	the successful completic	on of the course, students will be able to:					
CO Nos.		Course Outcomes	Knowl on	edge revise Taxo	Leve ed Blo nom	l (Ba: bom's y)	sed ;
CO1	Explain the Constructio	n and operation of DC Machines			K2		
CO2	Explain the Theory and transformer	operation, phasor diagram of			K2		
CO3	Explain the Concept of	synchronous machines			K2		
CO4	Illustrate the three pha	se Induction motor principle			K2		
CO5	Illustrate the single pha	se Induction motor principle			К2		

1						1
L	Μ			L		
L	М					
L	М					
L			М			
L	М					
		L M L M L L	L M L M L L L	L M L M M L M	L M L M L M L M L M	L M M L M M L M M L M M

UNIT I DC MACHINES	9							
Construction of DC Machines, Methods of excitation, Magnetization and operating characteristics of generators, Starters. Speed-torque characteristics of DC motors. Speed control .Losses and efficiency.								
UNIT II TRANSFORMERS	9							
Theory and operation, Phasor diagram, equivalent circuit, open and short circuit tests. Performance estimation, Auto-transformers. Parallel operation, three phase transformer Connections. Instrument transformers: CT&PT								
UNIT III SYNCHRONOUS MACHINES	9							
Alternators - types and constructional features - emf equation, Concept of synchronous rearest regulation by EMF and MMF methods, Synchronous motor starting and V curves.	eactance,							
UNIT IV INDUCTION MACHINES	9							
Poly phase Induction motors - types and constructional features - equivalent circuit - starting an control, circle diagram, induction generators.	and speed							
UNIT V SINGLE PHASE INDUCTION MACHINES	9							
Single phase induction motors -types and constructional features-principle of operation eq circuit based on double revolving field theory, Shaded pole induction motor-Linear reluctance Hysteresis motor-AC series motor.	equivalent ce motor-							
TOTAL: 45 P	PERIODS							
TEXT BOOKS:								
3. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7 th Edition, 2007.								
4. Nagrath, I.J.and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education Private Publishing Company Ltd., 4 th Edition, 2010.	te Limited							
REFERENCE BOOKS:								
5. M. G. Say, 'Performance and design of Alternating Current Machines', John Wiley an Publications, 3rd Edition, 1983.	and Sons							
 Arthur Eugene Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw Hill Ec Publications, 6th Edition, 2002. 	Education							
 Miller, T.J.E., 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendor Oxford, 1989. 	on Press-							

COURSE CODE:	
10213EE122	

COURSE TITLE: INDUSTRIAL ELECTRICAL SYSTEMS

L T P C

COURSE CATEGORY: Open Elective

PREAMBLE: This course helps to understand about overview of electric systems in manufacturing

PREREQUISITE COURSES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES :

The objectives of the course are to make the students,

- Introduce various methods of effectively and efficiently utilizing Electrical Energy for different and desired applications.
- Teach the various Electrical Lighting principles and their applications.
- Impart knowledge on effective utilization of Electrical Drives, Electrical Traction and Electro Mechanical process.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Basics about electrical equipment are in manufacturing.	К2
CO2	Application of electrical equipment's in different types of industries.	К2
CO3	Types and working of electric traction systems.	К2
CO4	Industry oriented consumption of electrical energy.	К2
CO5	Basics about Illumination and its types.	К2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н												L	М
CO2	н							н		м	н		L	М
CO3	н			н				н		м	н		L	М
CO4		м	м	L		м		м		м				
CO5										н				
	1		1	1	1		1		1	1		1	1	1

UNIT IELECTRIC DRIVES AND CONTROL9Group drive – Individual drive – selection of motors – starting and running characteristics– Mechanical features of electric motors – Drives for different industrial applications - Choice of drives – power requirement calculation.UNIT IIELECTROMECANICAL PROCESSES9Electrolysis – polarization factor – preparation work for Electro plating – Tanks and other equipments – Calculation of energy requirements – Methods of charging and maintenance – Ni-Iron and Ni- cadmium batteries – Lead acid batteries ,Components and materials – Chemical reactions – Capacity rating of batteries – Battery thries – BatteryUNIT IIIELECTRIC TRACTION9Traction system – Speed time characteristics – Series and parallel control of D.C. motors -Open trolley bus – A.C traction and recent trend. Magnetic Levitation9UNIT IVELECTRIC HEATING AND WELDING9Resistance, Inductance and Arc furnaces – Construction and fields of application – Losses in oven and efficiency - High frequency - Dielectric heating – Characteristics of carbon and metallic arc welding – butt welding – spot welding.9Production of light – Determination of MHCP and MSCP – Polar curves of different types of sources – Rousseau's construction – Lighting schemes and calculations – Factory lighting – Electric lamps – Gaseous discharge – High pressure and low pressure.TOTAL: 4S PERIODSTEXTBOOKS:I.0 pen Shar Taylor, 'Utilization of Electrical Energy', Oriented Longma-Limited (Revised in SI Units), 1971 Units), 1971 Uppal S.L, 'Electric Power', Khanna Publishers, 1988.ISoni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggineering',	COURSE CONTEN	NT :	-
Group drive – Individual drive – selection of motors – starting and running characteristics– Mechanical features of electric motors – Drives for different industrial applications - Choice of drives – power requirements – claitons values intervalues – Ni-ron and Ni- cadmium batteries – Lead acid batteries , Components and materials – Chemical reactions – Capacity rating of batteries – Battery - charges. 9 UNIT II ELECTRIC TRACTION 9 Traction system – Speed time characteristics – Series and parallel control of D.C motors -Open circuited, shunt and bridge transitions – Tractive effort calculation – Electric barking – Tramways and trolley bus – A.C traction and recent trend. Magnetic Levitation 9 UNIT IV ELECTRIC THACTION 9 Resistance, Inductance and Arc furnaces – Construction and fields of application – Losses in oven and efficiency - High frequency - Dielectric heating – Characteristics of carbon and metallic arc welding – but welding – spot welding. 9 UNIT V ILLUMINATION 9 Production of light – Determination of MHCP and MSCP – Polar curves of different types of sources – Rousseau's construction – Lighting schemes and calculations – Factory lighting – Flood lighting – Electric lamps – Gaseous lischarge – High pressure and low pressure. 1. Open Shaw Taylor, 'Utilization of Electrical Energy', Oriented Longmans Limited (Revised in SI Units), 1971. 2. Uppal S.L, 'Electric Power', Khanna Publishers, 1988. REFERENCE BOOK: 1. Soni A. Chakrabarti, M.L.Soni, P.V.Gupt	UNIT I	ELECTRIC DRIVES AND CONTROL	9
UNIT IIELECTROMECANICAL PROCESSES9Electrolysis – polarization factor – preparation work for Electro plating – Tanks and other equipments – Calculation of energy requirements – Methods of charging and maintenance – Ni-iron and Ni- cadmium batteries – Lead acid batteries ,Components and materials – Chemical reactions – Capacity rating of batteries – Battery charges.UNIT IIIELECTRIC TRACTION9Traction system – Speed time characteristics – Series and parallel control of D.C motors -Open circuited, shunt and bridge transitions – Tractive effort calculation – Electric braking – Tramways and trolley bus – A.C traction and recent trend. Magnetic Levitation9UNIT IVELECTRIC HEATING AND WELDING9Resistance, Inductance and Arc furnaces – Construction and fields of application – Losses in oven and efficiency - High frequency - Dielectric heating – Characteristics of carbon and metallic arc welding – but welding – spot welding.9UNIT VILLUMINATION9Production of light – Determination of MHCP and MSCP – Polar curves of different types of sources – Rousseau's construction – Lighting schemes and calculations – Factory lighting – Flood lighting – Electric lamps – Gaseous discharge – High pressure and low pressure.TEXTBOOKS:1Open Shaw Taylor, 'Utilization of Electrical Energy', Oriented Longmans Limited (Revised in SI Units), 1971.2.Uppal S.L, 'Electric Power', Khanna Publishers, 1988.REFERENCE BOOKS:11.Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggine=ring', Khanna Publishers, 2000.2.A.I.Starr, 'Generation, Distribution and Utilization of Electrical Energy'.3.	Group drive – In features of elect requirement calc	dividual drive – selection of motors – starting and running cha tric motors – Drives for different industrial applications - Cl sulation.	aracteristics– Mechanical noice of drives – power
Electrolysis – polarization factor – preparation work for Electro plating – Tanks and other equipments – Calculation of energy requirements – Methods of charging and maintenance – Ni-iron and Ni- cadmium batteries – Lead acid batteries , Components and materials – Chemical reactions – Capacity rating of batteries – Battery charges. UNIT III ELECTRIC TRACTION 9 Traction system – Speed time characteristics – Series and parallel control of D.C motors -Open circuited, shunt and bridge transitions – Tractive effort calculation – Electric braking – Tramways and cirolley bus – A.C traction and recent trend. Magnetic Levitation 9 UNIT IV ELECTRIC HEATING AND WELDING 9 Resistance, Inductance and Arc furnaces – Construction and fields of application – Losses in oven and efficiency - High frequency - Dielectric heating – Characteristics of carbon and metallic arc welding – butt welding – spot welding. 9 Production of light – Determination of MHCP and MSCP – Polar curves of different types of sources – Rousseau's construction – Lighting schemes and calculations – Factory lighting – Flood lighting – Electric lamps – Gaseous discharge – High pressure and low pressure. TOTAL: 45 PERIODS TEXTBOOKS: I. Open Shaw Taylor, 'Utilization of Electrical Energy', Oriented Longmans Limited (Revised in SI Units), 1971. 2. 2. Uppal S.L, 'Electric Power', Khanna Publishers, 1988. 1. REFERENCE BOOKS: I. Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggineering', Khanna Publishers, 2000.	UNIT II	ELECTROMECANICAL PROCESSES	9
UNIT IIIELECTRIC TRACTION9Traction syster- Speed time characteristics - Series and parallel control of D.C motors -Open circuited, shunt → bridge transitions - Tractive effort calculation - Electric → king - Tramways and trolley bus - A.C + → crian and recent trend. Magnetic LevitationID.C motors -Open circuited, shunt → bridge transitions - Tractive effort calculation - Electric → king - Tramways and trolley bus - A.C + → crian and recent trend. Magnetic LevitationUNIT IVELECTRIC HEATING AND WELDING9Resistance, Inductor and Arc furnaces - Construction and fields of application - Losses in oven and efficiency - High frequency - Dielectric heating - Characteristics of carbon and metallic arc welding - butt welding - so welding.9UNIT VILLUMINATION9Production of light - Determination of MHCP and MSCP - Polar curves of different types of sources - Rousseau's construction - Lighting schemes and calculations - Factory lighting - Flood lighting - Electric lamps - Gaseous discharge - High pressure and low pressure.TEXTBOOKS:TOTAL: 45 PERIODS1.Open Shaw Taylor, 'Utilization of Electrical Energy', Oriented Longma- Limited (Revised in SI Units), 1971.2.Uppal S.L, 'Electric Power', Khanna Publishers, 1988.EFFERENCE BOOKS:1.Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggine=ing', Khanna Publishers, 2000.2.A.I.Starr, 'Generation, Transmission and Utilization of Electrica Energy'.3.C. L Wadhwa , 'Generation ,Distribution and Utilization of Electrica Energy'.	Electrolysis – pol Calculation of en batteries –Lead batteries – Batte	arization factor – preparation work for Electro plating – Tanks a ergy requirements – Methods of charging and maintenance – I acid batteries ,Components and materials – Chemical reactio ry charges.	and other equipments – Ni-iron and Ni- cadmium ns – Capacity rating of
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UNIT IVELECTRIC HEATING AND WELDING9Resistance, Inductor and Arc furnaces – Construction and fields of application – Losses in oven and efficiency - High frequency - Dielectric heating – Characteristics of carbon and metallic arc welding – butt welding – spot welding.UNIT VILLUMINATION9Production of light – Determination of MHCP and MSCP – Polar curves of different types of sources – Rousseau's construction – Lighting schemes and calculations – Factory lighting – Flood lighting – Electric lamps – Gaseous lischarge – High pressure and low pressure.TOTAL: 45 PERIODSTEXTBOOKS:1.Open Shw Taylor, 'Utilization of Electrical Energy', Oriented Longmas Limited (Revised in SI Units), 1971.2.Uppal S.L, 'Electric Power', Khanna Publishers, 1988.REFERENCE BOOK:1.Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text box on Power System Enggine=ing', Khanna Publishers, 2000.2.A.I.Starr, 'Generation, Transmission and Utilization of Electric Power', ELS, 1978.3.C. L Wadhwa , 'Generation ,Distribution and Utilization of Electrical Energy'.	Traction system circuited, shunt trolley bus – A.C	 – Speed time characteristics – Series and parallel contro and bridge transitions – Tractive effort calculation – Electric I traction and recent trend. Magnetic Levitation 	I of D.C motors -Open braking – Tramways and
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UNIT VILLUMINATION9Production of Nik CP and MSCP – Polar curves of different types of sources and calculations – Factory lighting – ElectricRousseau's construction – Lighting schemes and calculations – Factory lighting – Electricans - Gaseous discharge – High pressure and low pressure.TOTAL: 45 PERIODSTEXTBOOKS:1.0 open Shurt Taylor, 'Utilization of Electrical Energy', Oriented Longmur2.Uppal S.L. 'Electric Power', Khanna Publishers, 1988.REFERENCE BOUND Sensitive Multipation of Electrical Energy', A text box on Power System1.Soni A. Lakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text box on Power System2.A.I.Starr, 'Generation, Transmission and Utilization of Electrica Power', Starta3.C. L Wathartion, Jistribution and Utilization of Electrical Energy'.	Resistance, Induce efficiency - High butt welding – sp	ctance and Arc furnaces – Construction and fields of applicati frequency - Dielectric heating – Characteristics of carbon an pot welding.	on – Losses in oven and d metallic arc welding –
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TOTAL: 45 PERIODS TEXTBOOKS: 1. Open Shaw Taylor, 'Utilization of Electrical Energy', Oriented Longmans Limited (Revised in SI Units), 1971. 2. Uppal S.L, 'Electric Power', Khanna Publishers, 1988. REFERENCE BOOKS: 1. Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggineering', Khanna Publishers, 2000. 2. A.I.Starr, 'Generation, Transmission and Utilization of Electric Power', ELBS, 1978. 3. C. L Wadhwa , 'Generation ,Distribution and Utilization of Electrical Energy'.	Production of lig Rousseau's const lamps – Gaseous	ht – Determination of MHCP and MSCP – Polar curves of diff ruction – Lighting schemes and calculations – Factory lighting - discharge – High pressure and low pressure.	erent types of sources – – Flood lighting – Electric
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 REFERENCE BOOKS: Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggineering', Khanna Publishers, 2000. A.I.Starr, 'Generation, Transmission and Utilization of Electric Power', ELBS, 1978. C. L Wadhwa , 'Generation , Distribution and Utilization of Electrical Energy'. 	2. Uppar S.I	-, Electric Power , Khanna Publishers, 1988.	
 Soni A. Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text book on Power System Enggineering', Khanna Publishers, 2000. A.I.Starr, 'Generation, Transmission and Utilization of Electric Power', ELBS, 1978. C. L Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy'. 	REFERENCE BOO	KS:	
 A.I.Starr, 'Generation, Transmission and Utilization of Electric Power', ELBS, 1978. C. L Wadhwa , 'Generation ,Distribution and Utilization of Electrical Energy'. 	1. Soni A. Engginee	Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text k ering', Khanna Publishers, 2000.	book on Power System
3. C. L Wadhwa , 'Generation , Distribution and Utilization of Electrical Energy'.	2. A.I.Starr,	'Generation, Transmission and Utilization of Electric Power', E	LBS, 1978.
	3. C. L Wad	hwa , 'Generation ,Distribution and Utilization of Electrical Ene	ergy'.

COURSE CODE: 10213EE123

COURSE TITLE: COMPUTER AIDED ANALYSIS OF ELECTRICAL APPARATUS

L T P C

COURSE CATEGORY: Open Elective

PREAMBLE: This course will provide in depth knowledge on DC & AC machines concepts by theoretically reading and practically simulating.

PREREQUISITE COURSES: Basic Electrical Engineering.

COURSE EDUCATIONAL OBJECTIVES:

To impart knowledge on

- To provide knowledge on purpose and procedure of Finite Element Analysis method.
- To educate the design, mesh creation and types of solvers in MagNet software by practical simulation.
- To provide knowledge on DC machine construction, working principle and DC series motor design using MagNet simulation software.
- To educate the operation of transformer by theoretical, design of core and shell type transformer using MagNet simulation software.
- To educate the concept of three phase Induction machines and design of squirrel cage induction motor using MagNet simulation software.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the purpose of FEA and types of Finite Elements	К2
CO2	Show the model of object, elements in 1D,2D,3D and types of solvers using MagNet software	КЗ
CO3	Explain the concept, types of DC machine and show the simulation of DC series motor using MagNet software	КЗ
CO4	Explain the principle, types of transformer and show the simulation of core, shell type transformer using MagNet software	КЗ
CO5	Explain the principle, types of DC machine and show the simulation of Squirrel cage induction motor using MagNet software	КЗ

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н		Н					М	М					
CO2	М		Н	L				Н	М					
CO3	М		М	Н	L			Н	М		М			
CO4	М		М	Н	L			Н	М		М			
CO5	М		М	Н	L			Н	М		М			
COURSE CONTENT	Γ:													
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UNIT I	INTRODUCTION TO FEA	9												
History- Purpose condition-general	of FEA- Discretization model-Mesh refinement- Types of Finite elem procedure for FEA (Preprocessing, solution, post processing)- Applicat	nents- Boundary on of FEA.												
UNIT II	BASICS OF MAGNET SOFTWARE	9												
Introduction-Desig two dimension de initial 2D mesh-Ty	gn of Object-Elements-Nodes- make component in a line- one dimensions in a line- one dimension of Cylinder, rectangular, cube —three dimension design of fan, v pes of solvers.	n design of line,- vheel, spanner												
UNIT III	DC MACHINE	9												
Principle-EMF equation- speed torque equation- Electrical/Mechanical characteristics- starters- applications - design of series DC motor: Wireframe model-solid model-Transient 2D with motion analysis.														
UNIT IV	TRANSFORMER	9												
Principle and open shell type transfor	Principle and operation-EMF equation-Phasor diagram, equivalent circuit-Application-design of core and shell type transformer: Wireframe model-solid model-static analysis.													
UNIT V	THREE PHASE INDUCTION MOTOR	9												
Three phase Indu starter- applicatio motion analysis.	ction Motor types and constructional features–Torque equation-sta ns, design of Squirrel cage Motor: Wireframe model-solid model- Tr	r delta and DOL ransient 2D with												
	ТО	TAL: 45 PERIODS												
TEXTBOOKS:														
1. Reddy.J.N	., 'An Introduction to the Finite Element Method', 3 rd Edition, Tata McG	raw-Hill, 2005												
2. Seshu,P, ' ⁻	Fest book of Finite Element Analysis', Prentice-Hall of India Pvt.Ltd., Ne	w Delhi, 2007												
REFERENCE BOOK	S:													
1. Dr. P.S. Bh	imbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.													
2. Nagrath, I	J.and Kothari, D.P., 'Electrical Machines', Tata McGraw Hill Education	n Private Limited												
Publishin	g Company Ltd., 4th Edition, 2010.													
3. M. G. Say Publicatio	v, 'Performance and design of Alternating Current Machines', John ons, 3 rd Edition, 1983.	Wiley and Sons												
4. Rao,S.S., '	The Finite Element Method in Engineering', 3 rd edition, Butterworth He	inemann, 2004.												

COURSE CODE: COURSE TITLE:	L	т	Ρ	С					
10213EE124	GREEN ENERGY RESOURCES	3	0	0	3				
COURSE CATEGO	RY: Open Elective								
PREAMBLE: This Wind, Bio Energy	PREAMBLE: This course focuses on the renewable energy based electric energy generation: Solar, Wind, Bio Energy, Waste to energy, other renewable energy resources.								
PREREQUISITE COURSES: Basic Electrical Engineering.									
COURSE EDUCAT	IONAL OBJECTIVES :								
To impart knowle Concepts resources Environm Energy-er	dge on of the renewable energy sources like wind, solar, Bio and other ren s. Jental friendly energy production and consumption. Fficient systems and products for various applications.	ewat	ole er	nergy	'				
	ЛЕS :								

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain about Renewable Energy resources and its importance.	К2
CO2	Understand the process of photovoltaic power generation.	К2
CO3	Explain the process of power generation using wind energy resources.	К2
CO4	Summarize the power generation using Bio energy techniques.	К2
CO5	Summarize the fundamentals and the other renewable energy resource applications.	К2

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1											L	L	L	L
CO2		Н	Н					М	М					
CO3		Н												
CO4			Н		Н	L	Н				L	L		
CO5		L			L			М	М		L	L	М	М
COURS	E CON	TENT												
U	NIT I	IN	TRODU	ICTION									6	
Energy import	needs	s of Ir frenew	ndia, cl vable er	lassifica nergy re	ation c esource	of ener es.	rgy sou	urces,	energy	efficie	ency a	nd en	ergy s	ecurity,

UNIT II	SOLAR ENERGY	12								
Basic concepts, effect, solar cells PV system and e	types of collectors, collection systems, photo voltaic (PV) technolo , characteristics of PV systems, equivalent circuit, and array design, b fficiency calculations, applications.	ogy: solar thermal building integrated								
UNIT III	WIND ENERGY	9								
Wind power syst of generators ar operation,	Wind power systems, wind speed and power relation components, turbine types, turbine rating. Choice of generators and site selection, wind energy forecasting, variable speed operation, maximum power operation,									
UNIT IV	BIO ENERGY	9								
Bio-mass and bio characteristics, for	Bio-mass and bio-gas: principles of bio-conversion, bio-gas digesters types, gas yield, and combustion characteristics, fermentation and wet processes, applications-utilization for cooking									
UNIT V	OTHER RENEWABLE ENERGY RESOURCES	9								
Geothermal ener Fuel cells: types	rgy, ocean thermal energy, wave energy, Tidal energy, waste to energ and applications.	gy, heat to energy,								
	T	OTAL: 45 PERIODS								
TEXTBOOKS:										
1. Rai G.D,	'Non-conventional Energy Sources' Khanna Publishers, 2006.									
2. A.Duffie	and W.A.Beckmann, 'Solar Engineering of Thermal Processes', John V	Viley, 1980.								
REFERENCE BOO	DKS:									
1. F.Kreith	and J.F.Kreider, 'Principles of Solar Engineering', McGraw-Hill (1978).									
2. T.N.Vezi	roglu, 'Alternative Energy Sources', Vol 5 and 6, McGraw-Hill (1978).									
3. David Hu	u. 'Hand Book of Industrial Energy Conservation', Van Nostrand Co., 1	983.								
ONLINE RESOUR	CES:									

1. books.google.co.in

2. www.scribd.com/.../Solar-engineering-of-Thermal-processes-Duffie

COURSE CODE	: COURSE TITLE:	L	т	Ρ	С						
10213EE125	ROBOTICS AND AUTOMATION	3	0	0	3						
COURSE CATE	GORY: Open Elective										
PREAMBLE: To automation.	enable students to understand about the working conce	ots of rol	oot an	d its r	ole in						
PREREQUISITE	PREREQUISITE COURSES: Basic Electrical Engineering										
COURSE EDUCATIONAL OBJECTIVES :											
To stue	• To study the basics of robots.										
To disc	uss about the different actuators of Robot.										
To und	erstand the kinematics and inverse kinematics of robots.										
• To ana	lyse the trajectory planning for robot.										
• To elal	porate the control of robots for some specific applications.										
	OMES :										
Upon the s	uccessful completion of the course, students will be able to:										
CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)									
CO1	Understand the basics of robots		К2								
CO2	CO2 Elaborate the function of different sensors in the robot K2										
CO3	Understand the concepts of gripper and robot control		К2								
CO4	Write program to use robot for a typical application		К2								
CO5	Manipulate robots in different applications		K2								

CORRELATION OF COs WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н													
CO2	н							н		м	н			
CO3	н			н				н		м	н			
CO4		м	м	L		м		м		м			М	М
CO5										Н			М	М

COURSE CONTEN	Т:								
UNIT I	BASIC CONCEPTS	9							
Definition and or freedom – Asimo	igin of robotics – different types of robot – various generation v's laws of robotics – dynamic stabilization of robots.	ns of robots – degrees of							
UNIT II	POWER SOURCES AND SENSORS	9							
Hydraulic - pneu machines in robo optic and tactile s	Hydraulic - pneumatic - electric drives – variable speed arrangements – path determination – micro machines in robotics – artificial intelligent– machine vision – ranging – laser – acoustic – magnetic, fibre optic and tactile sensors.								
UNIT III	MANIPULATORS, ACTUATORS AND GRIPPERS	9							
Construction of manipulator cont	Construction of manipulators – manipulator dynamics and force control – manipulator control circuits – end effectors – grippers – design consideration								
UNIT IV	KINEMATICS AND PATH PLANNING	9							
Kinematic proble programming lan	ems - Solution of inverse kinematics problem – hill climb guages-sliding mode control	oing techniques – robot							
UNIT V	APPLICATIONS	9							
Multiple robots - robots in manufa	 robot cell design – selection of robot – Micro and Nano rob cturing and non- manufacturing applications. 	ots- machine interface -							
		TOTAL: 45 PERIODS							
TEXTBOOKS:									
 Mikell P. Ghosh, <i>Greense</i> 	 Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., 'Industrial Robotics', Mc Graw-Hill Singapore, 1996. Ghosh, 'Control in Robotics and Automation: Sensor Based Integration', Allied Publishers, Chennai, 1998. 								
REFERENCE BOO	KS:								
1. Klafter R Prentice	 Klafter R.D., Chimielewski T.A., Negin M., 'Robotic Engineering – An integrated Approach', Prentice Hall of India, New Delbi, 1994 								

2. Mc Kerrow P.J. 'Introduction to Robotics', Addison Wesley, USA, 1991.

COURSE	CODE:	COURSE TITLE:	L	т	Р	С			
10213E	E126	WIND ENERGY TECHNOLOGY	3	0	0	3			
COURSE CAT	EGORY: Op	en Elective							
PREAMBLE: presents a br	Wind energ oad overvie	y is the fast-growing renewable source for electri w of wind energy technology.	city gene	eration	. This c	ourse			
PREREQUISITE COURSES: Basic Electrical Engineering									
COURSE EDU	CATIONAL	OBJECTIVES :							
• To le	arn about P	ower extraction from wind energy.							
 To di 	stinguish th	e components and design of wind tower.							
• To ur	nderstand w	orking principle of induction generator, synchronou	us genera	ator.					
COURSE OUT	COMES :								
Upon the	e successful	completion of the course, students will be able to:							
CO Nos.		Course Outcomes	Knowle on r	edge Le evised Taxono	vel (Ba Bloom omy)	ased 's			
CO1	Express th	e relation between speed and power		К2					
CO2	Classify the components of wind tower			К2					
CO3	Demonstrate the design features of wind tower								
CO4	Explain th	e principle of operation of Types of generator		К2					
CO5	Understar	d operation and control of wind power	K2						
L	1	I							

CORRELATION OF COS WITH POS AND PSOS

cos	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L				L				L	М				
CO2	L								L	М				
CO3	Н		Н					М	L	М			L	М
CO4	L							М	М	М				
CO5	L		М		М			Н	Μ	М			L	М
COURS	E CON	TENT :												
UNIT	I IN	ITRODU	JCTION										9	
Speed Wind P	Speed and Power Relations, Power Extracted from the Wind, Rotor Swept Area, Air Density, Global Wind Patterns, Wind Speed Forecasting, Wind Resource in India.													

UNIT I	WIND TURBINE COMPONENTS	9								
System Genera	Components: Tower, Turbine Blades, Yaw Control, Pitch Control, or, Transformer, Anemometer.	Gearbox, Safety brakes,								
UNIT II	TOWER DESIGN	9								
System Vertical	Design Features: Number of Blades, Rotor Upwind, Downwind, Horiz axis wind turbines, Spacing of the Towers.	ontal axis wind turbines,								
UNITI	TYPES OF GENERATORS	9								
Types o Grid int	Types of Generator: Induction generator, Synchronous generator, Fixed and variable speed operations, Grid integration.									
	CONTROL OF WIND POWER	9								
Maximu Control	Maximum Power Operation: Constant Tip-Speed Ratio Scheme, Peak Power Tracking Scheme; System Control Requirements: Speed and Rate Control.									
		TOTAL: 45 PERIODS								
TEXTBO	OKS:									
1.	Mukund R. Patel 'Wind and Solar Power Systems: Design, Analysis, ar (1999).	nd Operation' -CRC Press								
2.	Sathyajith Mathew, 'Wind Energy Fundamentals, Resource Analysis (2006).	and Economics' Springer								
REFERE	NCE BOOKS:									
1.	S.N.Bhadra, D.Kastha,S.Banerjee, 'Wind Electrical Systems', Oxford Uni	versity Press, 2010.								
2.	Ion Boldea, 'Variable Speed Generators', Taylor & Francis Group, 2006.									
3.	3. E.W. Golding "The Generation of Electricity by Wind Power", Redwood Burn Ltd., Trowbridge, 1976.									
4.	N. Jenkins, 'Wind Energy Technology' John Wiley & Sons, 1997.									

COURSE	CODE:	COURSE TITLE:		L	Т	Р	С				
10213E	E127	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	•	3	0	0	3				
COURSE CAT	EGORY: Op	en Elective	·								
PREAMBLE: This course will enable the students to understand the basic concepts of electrical safety and regulations											
PREREQUISI	PREREQUISITE COURSES: Basic Electrical Engineering										
COURSE EDU	CATIONAL	OBJECTIVES:									
The objective	es of the co	urse are to make the students,									
• To st impr	udy the ele ovement.	ctrical safety rules, regulations and quality manage	ment	t by t	the po	wer fa	ctor				
COURSE OUT	COMES :										
Upon the	successful	completion of the course, students will be able to:									
CO Nos.		Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)								
C01	Understar significan	tand the Indian electricity rules and their K2									
CO2	Explain th agricultur	cplain the safety standard in residential, commercial, and K2									

CORRELATION OF COs WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	н		Н					М	М					
CO2	м		Н	L				Н	М					
CO3	м		М	Н	L			Н	М		М			
CO4	М		М	Н	L			н	М		М			
CO5	М		М	Н	L			Н	М		М		L	L

COURSE CONTENT:

CO3

CO4

CO5

UNIT I INDIAN ELECTRICITY RULES AND ACTS AND THEIR SIGNIFICANCE

Learn about electrical safety installation, testing.

Understand about flashovers and corona discharge.

Understand about electrical safety in distribution system.

9

К2

К2

К2

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

UNIT II	ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS	9								
Wiring an shock — n Don'ts for	d fitting – Domestic appliances – water tap giving shock – shock from nulti-storied building – Temporary installations – Agricultural pump in safety in the use of domestic electrical appliances.	n wet wall – fan firing nstallation – Do's and								
UNIT III	SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE	9								
Preliminar quality an safeguard	documentation – field - safety precautions –									
UNIT IV	ELECTRICAL SAFETY IN HAZARDOUS AREAS	9								
Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requ – Specifications of electrical plants, equipment's for hazardous locations – Classification of ec enclosure for various hazardous gases and vapours – classification of equipment/enclo hazardous locations.										
UNIT V	ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM	9								
Total qual factor – improvem	ity control and management – Importance of high load factor – Disady Causes of low P.F. – power factor improvement – equipment's - ent.	vantages of low power – Importance of P.F.								
		TOTAL: 45 PERIODS								
TEXT BOO	KS:									
1. Ra Kł	ao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and nanna Publishers, 1988.	Safety Management',								
2. Pr Co	adeep Chaturvedi, 'Energy Management Policy, Planning and Utilizatio ompany, 1997.	n', Concept Publishing								
REFERENC	CE BOOKS:									
1. Na	agrath, I.J. and Kothari, D.P., 'Power System Engineering', Tata McGraw	Hill, 1998.								
2. G	upta, B.R., 'Power System Analysis and Design', S.Chand and Sons, 2003.									
3. W	3. Wadhwa, C.L., 'Electric Power Systems', New Age International, 2004									

COURSE CODE:		L	Т	Т Р 0 2	С
10213EE201	DEVELOPMENT	2	0	2	3

COURSE CATEGORY: Open Elective

PREAMBLE: The course is designed as lab dominated theory course to make the student acquire thorough knowledge in the field of power supply design for the given devices or equipments. Since power supply system is absolutely necessary for all equipments which produce constant voltage at the output irrespective of changes in supply voltage. This course is designed from understanding the fundamental of SMPS to designing an SMPS for the given equipments.

PREREQUISITE COURSES: Basic Electrical Engineering, Basic Electronics Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To understand detailed insight of SMPS and its various topologies
- To design and fabricate power supply system for the given equipment.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Deliver the fundamental concept of SMPS	К2
CO2	Understand the working of rectifier, chopper, amplifier circuit, voltage and current sensors.	К2
CO3	Explain the various SMPS topologies	К2
CO4	Design SMPS for specific applications	К6
CO5	Analyze the power quality issues using power quality analyzer	К3

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		Н								М			
CO2	М							L			L			
CO3			М								М			
CO4			Н					М			Μ			
CO5			М										L	L

COURSE CO	INTENT:	
UNIT I	INTRODUCTION	6
Introductio advantages	n to SMPS-types-evolution- need of SMPS- Linear Regulator vs SMPS -Applications	– Block diagram-
UNIT II	COMPONENTS	6
Rectifier typ regulator a role of chop	pes and its operations-purpose of amplifier in SMPS-amplifier circuit used nd its types-comparator and its types- importance of comparator-Chopper oper in SMPS	l in SMPS- voltage - definition-types-
UNIT III	SMPS CONVERTER TOPOLOGIES	6
Buck, Boost	, Buck-Boost, Push-Pull, Fly back, Resonant, forward Converter- Operation.	
UNIT IV	DESIGN OF SMPS	6
Selection of cycles- com	f switching devices for SMPS-switching frequency-PWM techniques-switchi parator design- need of voltage and current sensors and types	ng losses-duty
UNIT V	POWER QUALITY ASSESSMENT	6
Power qual harmonics power qual	ity analyzer-block diagram and its working-applications-measurement of cuat source side of SMPS -UPS output side-measurement of input power tity issues in load side for single phase and three phase loads.	urrent and voltage factor, analysis of
	т	DTAL: 30 PERIODS
ТЕХТ ВООК	S:	
1. Kei Edu	th Billings, Taylor Morey, 'Switch mode Power Supply Handbook', 3 rd Edi Ication, New York, 2012.	ition, McGraw-Hill
2. Ma 797	niktala, Sanjaya (2006), Switching Power Supplies A to Z, Newnes /Elsev '0-0	ier, ISBN 0-7506-
REFERENCE	BOOKS:	
1. Abr Edi	raham I. Pressman, Keith Billingss, Taylor Morey 'Switching Power Su tion, New York: McGraw-Hill, 1999	ipply Design', 3 rd
2. ON Des	Semiconductor (July 11, 2002). 'SWITCHMODE Power Supplies—Refere sign Guide' (PDF). Retrieved 2011.	ence Manual and
EXPERIMEN	ITS: (15 PERIODS)	
1) Identifi	cation, testing of components and its terminals used in SMPS	
2) a. Selec	tion of energy storage inductor, output filter capacitor.	
b. Stud	y the working of various high frequency switching devices	

- 3) a. Selection of switches, snubber circuit design
 - b. Study of Magnetic circuits and Transformer
- 4) To Generate Pulse width modulation signal using different circuits
- 5) a. Design of feedback controller and amplifier circuit
 - b. Op-amp circuits for current and voltage sensing in converters.
- 6) a. Measurement of output voltage using voltage sensor
 - b. Study the working of tiny fly back step down transformer
- 7) Design and testing of a voltage regulator circuit
- 8) Design and testing of simple DC chopper
- 9) Design of non-isolated DC-DC converters in different operating modes
- 10) Microcontrollers selection to use in SMPS circuits
- 11) Study of popular PWM Control IC's (SG 3525,TL 494,MC34060 etc.)
- 12) Study of popular PFC Control ICs MC34062 and UC 3854
- 13) Design of driver circuits
- 14) Design and development of SMPS and measure the input power factor and THD of input voltage and current using a power quality analyzer.
- 15) Troubleshooting of SMPS.

COURS	E CODE:	COURSE TITLE:	L	Т	Р	С
10213	BEE301	VOLTAGE STABILIZER FABRICATION	0	0	2	1
COURSE CA	ATEGORY: Op	en Elective				
PREAMBLE house hold to designin PREREQUIS	This course I appliances. T g a voltage sta SITE COURSES	includes the development of skills in power supp This course is designed from understanding the fu abilizer for the given power rating.	oly unit which Indamental Ingineering	h is es of volt	sential age sta	for al bilizei
	DUCATIONAL	OBJECTIVES:				
The object	ives of the cou	urse are to make the students,				
• Ide	ontify the real	irement of voltage stabilizer for domestic equinr	nents			
• To	design of trar	informer for a given power rating of voltage stability	lizer.			
• To	understand d	esign procedures of relay driver circuit for voltag	e stabilizer.			
• To	familiarize wi	th the techniques for trouble shooting the voltag	e stabilizer f	or any	proble	m.
COURSE O	UTCOMES :					
Upon t	he successful	completion of the course, students will be able to	o:			
CO Nos.		Course Outcomes	Level of (Based or ta	learnin n revise nxonon	ig dom ed Bloo ny)	ain m's
CO1	Understand	the basics of voltage stabilizer		K2		
CO2	Design of tra	ansformer for voltage stabilizer		K6		
CO3	Design of re	lay driver circuit		K6		
	1					

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	М	L	М	М		L				Н		Н		
CO2	L	М	L	Н		М				Н		Н	L	L
CO3	М	М	Н	Н		Н				L		Н	L	L
CO4	L	М	L	Н		L				Н		Н	М	М

COURSE CONTENT:

DESIGN OF VOLTAGE STABILIZER

Introduction-Need of voltage stabilizer-Power rating calculation-Block diagram- complete circuit and its operation -Relay driver circuit design-Comparator design-Transformer design

EXPERIMENTS

- 1. Identification of components and its terminals used in voltage stabilizer.
- 2. Design and development of transformer for given power rating.
- 3. Design and development of comparator circuit for voltage stabilizer.
- 4. Design and development of relay driver circuit used in voltage stabilizer.
- 5. Voltage measurement using voltage sensor.
- 6. Design of amplifier circuit for voltage stabilizer.
- 7. Demonstration and testing of voltage stabilizer for various input voltage.
- 8. Trouble shooting of voltage stabilizer.

TOTAL: 30 PERIODS

TEXTBOOKS:

 M. Lotia 'Modern Voltage Stabilizer Servicing: Introduction, Basic Principle and Repairing', ISBN 10: 8176562831 / ISBN 13: 9788176562836, BPB Publications, 2006.

REFERENCE BOOKS:

 Osama Butt 'Automatic Voltage Stabilizer by Using Pulse Width Modulation', ISBN 10: 365989317X / ISBN 13: 9783659893179, Published by LAP Lambert Academic Publishing Jun 2016, 2016.

B.Tech. Programme Specialization in Computer Systems

List of Courses (18 Credits)

S.NO.	COURSE CODE	COURSE NAME	L	т	Р	С
1.	10212EE101	Computer Architecture	3	0	0	3
2.	10212EE102	Operating Systems	3	0	0	3
3.	10212EE103	Object Oriented Programming	3	0	0	3
4.	10212EE104	Data Structures and Algorithms	3	0	0	3
5.	10212EE105	Computer Networks and Communication	3	0	0	3
6.	10212EE106	Artificial Intelligence	3	0	0	3

COL	JRSE CO	DE:			COU	RSE TIT	LE:			L	-	Т	Р	С
10	212EE1	01		со	MPUTE	R ARCHI	TECTUR	E		3	;	0	0	3
COURS	SE CATE	GORY: S	Specializ	ation										
PREAN unit, co	IBLE: In ontrol u	this cou nit and	urse, stu I/O unit	dents st of a dig	tudy the ital com	basic st puter ar	ructure nd its fui	of ar nctio	rithmet n.	ic and	l logi	cal u	nit, m	emory
PRERE	QUISITE		ES: NIL											
COURS • •	E EDUC To und To stu floatin To stu To stu	CATIONA derstand idy the ng-point dy the d dy the t	AL OBJE d the bas design operation lifferent ypes of	CTIVES : sic struc of arith ons ways of control	ture and metic a f commu unit tecl	d operat nd logic unicating hniques	ion of d unit ar g with I/ and the	igital nd im O de conc	compund pleme vices an cept of	iter ntatio nd sta pipeli	n of ndai ning	f fixe rd I/C	d poir) inter	nt and faces
COURS Upon t	COURSE OUTCOMES : Upon the successful completion of the course, students will be able to:													
CO Nos.	Course Outcomes Knowledge Level (Based on revised Bloom's Taxonomy)													
C01	Expla a digi	in the b ital com	asic stru puter.	ucture a	nd funct	tional op	peration	of			ĸ	(2		
CO2	Fami for in	liarize w nplemer	vith arit	hmetic a em in ha	algorithi rdware.	ms and	procedu	ure			K	(2		
CO3	Elabo instru units	orate th uctions v	ie pipel with mir	ine for nimum l	consist nazards	ent exe in data	ecution process	of ing			K	(2		
CO4	Sumr stanc	marize d lard inte	the diff erfaces i	erent t [.] n comm	ypes of unicatic	I/O d€ on	evices a	nd			ĸ	(2		
CO5	Ident Mana	ify pe	rforman t and de	ice con sign of a	nsiderat a digital	ion in comput	Memo er.	ory			K	(3		
CORRE		I OF CO	SAND P	Os										
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	РО	8 PC	09	PO1(0 P	011	PO12
CO1	Н		М										L	М
CO2	М	М	М	L										L
CO3	М		М											
CO4	М		М											L
CO5	Н	М	М	L	М							L	L	

COURSE CO	NTENT :	
UNIT I	BASIC STRUCTURE OF COMPUTERS	9
Functional u locations a Addressing	units – Basic operational concepts - Bus structures – Software performance – nd addresses – Memory operations – Instruction and instruction sequ modes – Assembly language – Basic I/O operations .	- Memory Iencing –
UNIT II	ARITHMETIC UNIT	9
Addition an numbers – S numbers an	d subtraction of signed numbers – Design of fast adders –Multiplication of posi Signed operand multiplication and fast multiplication – Integer division – Floati d operations.	tive ng point
UNIT III	BASIC PROCESSING UNIT	9
Fundamenta Hardwired Instruction	al concepts – Execution of a complete instruction – Multiple bus organ control – Micro programmed control – Pipelining –Basic concepts – Data hazards – Influence on Instruction sets – Data path and control consideration.	iization – hazards –
UNIT IV	I/O ORGANIZATION	9
I/O device A	Access – Interrupts – DMA – Buses – Interface circuits – Standard I/O Interfaces	
UNIT V	MEMORY SYSTEM	9
Basic conce operation – requiremen	epts – Semiconductor RAM – ROM –Flash Memory – RAID operations - size and cost – Cache memories – Performance consideration – Memory Mai ts – Secondary storage- Virtual memory	Speed of nagement
	TOTAL: 45	PERIODS
TEXTBOOKS): 	
1. Carl Editi 2. Davi Harc	Hamacher, Zvonko Vranesic, Safwat Zaky, 'Computer Organization', McGraw ion, Reprint 2012. d A. Patterson and John L. Hennessy, 'Computer Organization and Dea dware/Software Interface', Fourth Edition, Elsevier, 2011	-Hill, Fifth sign: The
REFERENCE	BOOKS:	
1. Ghc 2. M.N 3. Beh 4. Johi 199	osh T. K., 'Computer Organization and Architecture', Tata McGraw-Hill, 3 rd Edition Morris Mano, 'Computer System Architecture', 3 rd Edition, Pearson Education, 2 roozParhami, 'Computer Architecture', Oxford University Press, 2007. n P. Hayes, 'Computer Architecture and Organization', 3 rd Edition, Tata McG 8.	on, 2011. 2007. Graw Hill,

	COUF		:			L	Т	Ρ	С					
	102	12EE102			0	PERATI	NG SYST	EMS	S		3	0	0	3
COUR	SE CA	FEGORY:	Specializ	ation										
PREAM	/BLE:	To prov	ide an int	roductic	on to the	e operat	ing syste	em f	funct	ions, de	esign an	d imp	lem	entation
of how	i an o	perating	system co	ontrols t	he comp	outing re	sources	and	d prov	vide ser	vices to	the us	sers	
PRERE	QUISI	TE COUF	RSES: NIL											
COUR	SE EDI	JCATION	IAL OBJEC	CTIVES :										
•	To u	ndersta	nd the str	ucture a	nd funct	ions of (SC							
•	To le	earn abo	ut Proces	ses, Thre	eads and	l Schedu	ling algo	orith	nms					
•	To u	ndersta	nd the pri	nciples c	of concu	rrency a	nd Dead	lock	<s< td=""><td></td><td></td><td></td><td></td><td></td></s<>					
Io learn various memory management schemes To study I/O menagement and File systems														
I o study I/O management and File systems														
COURSE OUTCOMES :														
Upont	the su	ccessful	completio	on of the	e course,	student	ts will be	e abl	le to:					
CO Knowledge Level (Based on revised														
No	5.			Course	Juttonia					Blo	oom's Ta	axono	my)	
со	1	Explain operati	the b ng system	asic ele n prograi	ements m and it	and ov s functio	erview ons	of			К	2		
CO	2	Apply t time p	he conce roblems	pt of pro	ocess ma	anagem	ent to re	eal			K	3		
CO	3	Illustrat schedu	te the ling algori	concept thms	s of	concurr	ency a	nd			K	2		
CO	4	Elabora manage	ite the ement teo	conce hniques	pts of and its	various impleme	memo entation	ory			К	2		
CO	5	Summa device	rize the F managem	ile mana ent	agement	t and Inp	out/outp	out			К	2		
CORRE	LATIC	ON OF CO	Ds WITH F	Os and	PSOs									
COs	PO	L PO2	PO3	PO4	PO5	PO6	PO7	P	08	PO9	PO10	PO1	1	PO12
CO1	н													
CO2	M	M												
CO3	М													
CO4	м				L							L		М
CO5	Н	L										L		

COURSE CONTENT :								
UNIT I	INTRODUCTION	9						
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.								
UNIT II	CPU SCHEDULE AND PROCESS	9						
Process concepts and scheduling, Operations on processes, Processes and Threads, Types of Threads, Multicore and Multithreading, Windows OS - Thread and Symmetric Multi-Processing - Introduction to RTOS and its applications - Linux operating system								
UNIT III	CONCURRENCY AND SCHEDULING	9						
Principles of Concur Deadlocks – preven algorithms	rrency - Mutual Exclusion, Semaphores, Monitors, Re tion- avoidance – detection, Scheduling- Types of S	eaders/Writers problem. Scheduling – Scheduling						
UNIT IV	MEMORY MANAGEMENT	9						
Memory manageme Hardware and contro memory managemen	Memory management requirements, Partitioning, Paging and Segmentation, Virtual memory - Hardware and control structures, Segmentation with Paging, Linux memory management, Windows memory management.							
UNIT V	FILE SYSTEM INTERFACE AND OPERATION	9						
File management – O management, I/O ma scheduling and Disk c	rganization, Directories, File sharing, and Record blocking, nagement and disk scheduling – I/O devices, I/O functions ache.	secondary storage , OS design issues, disk						
		TOTAL: 45 PERIODS						
TEXTBOOKS:								
 William Stallin 2011. 	ngs, 'Operating Systems – internals and design principles',	Prentice Hall, 7 th Edition,						
 Silberschatz, 2006. 	Peter Galvin, Greg Gagne 'Operating System Principles',	Wiley India, 7 th Edition,						
REFERENCE BOOKS:								
1. Andrew S. Ta Prentice Hall,	nnenbaum & Albert S. Woodhull, 'Operating System Desi 3 rd Edition, 2006.	gn and Implementation',						
2. Andrew S. Ta	nnenbaum, 'Modern Operating Systems', Prentice Hall, 3 ^{rc}	¹ Edition, 2007.						
3. Gary J.Nutt, '	Operating Systems', Pearson/Addison Wesley, 3 rd Edition 2	2004.						
4. Pramod Cha Prentice Hall	ndra P.Bhatt, 'An Introduction to Operating Systems India, 3 rd Edition, 2010.	Concepts and Practice',						

COL	JRSE C	ODE:			COURSE TITLE: L T P (
10	212EE	103		OBJECT	ORIEN	TED PRO	OGRAMI	MIN	G	3	0	0	3	
COURS	SE CAT	EGORY: S	Specializ	ation										
PREAN for rea	PREAMBLE: To understand and development C++ Programming language and mastering in OOPS for real time applications													
PRERE	QUISI	TE COURS	SES: NIL											
COURSE EDUCATIONAL OBJECTIVES :														
To understand Object Oriented Programming concepts and basic characteristics of Java														
•	To ki	now the p	orinciple	s of pac	kages, ir	nheritan	ce and i	nter	faces					
•	To d	efine exce	eptions a	and use	I/O stre	ams								
•	To d	evelop a j	ava app	lication	with thr	reads an	d gener	ics cl	asses					
•	To d	esign and	build si	mple Gr	aphical	User Int	erfaces							
COURS	SE OU	TCOMES:												
Upon t	he su	ccessful c	ompletio	on of the	e course	e, studer	nts will b	e ab	le to:					
CO Nos.			Co	ourse Ou	ıtcomes	;			Know revise	ledge d Bloc	Leve m's	el (Baseo Taxono	d on omy)	
CO1	Exp pro	lain the gramming	e funo g concep	damenta ots and i	als of ts featu	objeo res	ct-orient	ted			К2			
CO2	App imp	oly the co dementat	oncepts tion in re	of inhe al time	eritance applicat	and int tions	terface	for			К3			
CO3	lmp fun	lementat ctions	ion of	progra	mming	in C+-	+ and	its			К3			
CO4	Sun mu	nmarize t Iti-thread	he use and Ge	of virtua neric Pro	al functi ogramm	ions to i	impleme	ent			K2			
CO5	Illus	strate the	feature	s of eve	nt drive	n progra	amming.				К2			
CORRE	LATIC	ON OF CO	s WITH I	POs ANI) PSOs									
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	РС	08 PO9	PO	10	PO11	PO12	
CO1	Н		L											
CO2	Н	н	М	L	L									
CO3	Н	Н		L								L	М	
CO4	Н		М	М	L								L	
CO5	Н	М			L							L	L	
COURS	SE CON	NTENT :						•						
	ГІ	INTROD	JCTION	то оор	s							9		
										-				

Fundamentals of OOPS – Features of Object Oriented Programming – objects and classes - Encapsulation- Inheritance - Polymorphism- Control flow – Arrays – Strings – Pointers and Functions

UNIT II	INHERITANCE AND INTERFACES	9							
Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining ar interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning									
UNIT III	PROGRAMMING IN C++	9							
Constructo exception h	s and Destructors – Operator Overloading –Virtual Functions an ierarchy - Input / Output Basics - Reading and Writing Console	d Exception Handling -							
UNIT IV	MULTITHREADING AND GENERIC PROGRAMMING	9							
Differences synchronizi Programmi	Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.								
UNIT V	EVENT DRIVEN PROGRAMMING	9							
Graphics pr images - Ba event hiera Text Areas – Dialog Bo	Graphics programming - Frame – Components - working with 2D shapes - Using colour, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.								
		TOTAL: 45 PERIODS							
TEXTBOOK	5:								
1. Hei 2. Ca Hal	 Herbert Schildt, 'Java the Complete Reference', 8th Edition, McGraw Hill Education, 2011. Cay S. Horstmann, Gary Cornell, 'Core Java Volume – I Fundamentals', 9th Edition, Prentice Hall, 2013. 								
REFERENCE	BOOKS:								
1. Pau 2 Tim	Il Deitel, Harvey Deitel, 'Java SE 8 for programmers', 3 rd Edition, P oothy Budd, 'Understanding Object-Oriented Programming with	earson, 2015. Java', Updated Edition							

 Timothy Budd, 'Understanding Object-Oriented Programming with Java', Updated Edition, Pearson Education, 2000.

COURSE CODE:	COURSE TITLE:	L	Т	Ρ	С					
10212EE104	DATA STRUCTURES AND ALGORITHMS	3	0	0	3					
COURSE CATEGORY: Specialization										

PREAMBLE: This course will impart knowledge in various data structures and analysis of algorithm concepts for different applications.

PREREQUISITE COURSES: Nil

COURSE EDUCATIONAL OBJECTIVES :

- To study various data structure concepts like Stacks, Queues, Linked List, Trees and Files
- To overview the applications of data structures
- To be familiar with utilization of data structure techniques in problem solving
- To have a comprehensive knowledge of data structures and algorithm
- To carry out asymptotic analysis of algorithm

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain user defined data types, linear data structures for solving real world problems.	К2
CO2	Implement modular programs on nonlinear data structures and algorithms for solving engineering problems efficiently	КЗ
CO3	Illustrate special trees and Hashing Techniques	К2
CO4	Apply searching techniques in graph traversal	КЗ
CO5	Apply sorting techniques for real world problems	КЗ

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12
CO1	н	L	L									L
CO2	Н	М	М	L	L							L
CO3	Н	М	L		L						L	L
CO4	Н	М	L	L	L							L
CO5	Н	М	L	L	L							L

COURSE CO	NTENT :						
UNIT I	INTRODUCTION	9					
Introduction – The Problem Solving – Top down design Strategy – Algorithms Vs Programs– Implementations of algorithms – Program Verification – The efficiency of algorithms – Algorithmic Notation – Asymptotic Notation – Mathematical Induction – Analysis of Algorithms – Recurrence Relations.							
UNIT II	LINEAR DATA STRUCTURES	9					
Lists – Arrays – Linked Representation – Singly Linked List – Doubly linked List – Cursor Based Linked list – Applications of lists – Stacks – Stack ADT – Array Implementation – Applications – Linked List Design – Queue ADT – Implementation – Applications.							
UNIT III	TREES	9					
Basic Tree Search Tree	Concepts – Binary Trees – Implementation –Tree Traversals – s – AVL trees.	Applications – Binary					
UNIT IV	GRAPHS	9					
Basic Conce Shortest Pat	pts – Traversal – Minimum Spanning Tree – Applications – Net h Algorithm –Topological Sort.	tworks – Single Source					
UNIT V	BACK TRACKING	9					
The Genera Knapsack P Completene	l Method – 8 Queens Problem – Sum of Subsets – Graph Coloring roblem – Branch and Bound Method – Travelling Salesman ess	g – Hamiltonian Cycle – problem – P and NP					
		TOTAL: 45 PERIODS					
TEXTBOOKS	:						
1. Mar Edu	k Allen Weiss, 'Data Structures and Algorithm Analysis in C' cation, 2007.	, 2 nd Edition, Pearson					
2. Ree	ma Thareja, 'Data Structures Using C', Oxford Higher Education ,	1 st Edition, 2011					
REFERENCE	BOOKS:						
1. Sart Edit	aj Sahni, 'Data Structures, Algorithms and Applications in C ion, 2005.	++', McGraw Hill, 2 nd					
2. San Inte	jay Pahuja, 'A Practical Approach to Data Structures and Arnational, 1 st Edition, 2010.	Algorithms', New Age					

COL	JRSE CC	DDE:	COURSE TITLE:						L T P C					
10	212EE1	05	COM	PUTER N	ETWOR	KS AND	сомм	UNIO	CATION	3		0	0	3
COURS	SE CATE	GORY: S	Specializ	ation						•				
PREAMBLE: This course introduces the concepts and fundamentals of computer networks, data communication and techniques in layered network architecture and their protocols.														
PREREQUISITE COURSES: Data Structures														
COURSE EDUCATIONAL OBJECTIVES :														
 Build an understanding of the fundamental concepts of computer networking, protocols, architectures, and applications 														
•	 Gain expertise in design, implement and analyze performance perspective of ISO OSI layered Architecture 													
•	Deal v	vith the	major is	sues of	the laye	ers of the	e model.	•						
COURS	SE OUTO	COMES :												
Upon t	he succ	essful c	ompleti	on of the	e course	e, studer	nts will b	e ab	le to:					
со			Co	ourse Ou	itcomes				Knov	/ledge	Lev	el (E	Based	on
Nos.									revis	ed Blo	om'	s Tax	conor	ny)
CO1	Inter Com	pret the municat	e archi ion netv	tecture vork	and k	ouilding	blocks	of			К2			
CO2	Expla perfo	ain the prmance	e type: analyse	s of e of netv	networl vork	k topo	logy a	nd			К2			
CO3	Sumr mech routi	marize nanisms, ng proto	the e flow cols	rror de control	etection mecha	and nisms	correcti of varic	ion ous			К2			
CO4	Com trans	pare th mission	e perfo layer pi	ormance otocol	e of ne	etwork	layer a	nd			К3			
CO5	Elabo	orate th ciated pi	e funct rotocols	ionality	of vari	ious lay	er and	its			К2			
CORRE		I OF Cos		POs AND	PSOs									
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	РС	08 PO	9 P	010	PO	11	PO12
CO1	Н													L
CO2	Н	М		L										М
CO3	Н	Н	М	L								l		М
CO4	Н	Н	L	L								l	<u> </u>	М
CO5	Н	Μ	Μ	L								l	L [Μ
COURS		FENT :												
UNI		NTRODU	JCTION					_			_	ç	•	
Compi	iter ne	etworks	and	distribu	ted sv	stems	Classifi	catio	ns. net	work	str	uctu	res.	Data

Computer networks and distributed systems Classifications, network structures, Data communication, Data representation and Data flow, Connection Topology, Protocols and Standards, OSI model, Transmission Media

UNIT II	NETWORK TOPOLOGY TYPES	9							
Wired LAN, Wireless LAN, Virtual LAN-Techniques for Bandwidth utilization- Multiplexing Frequency division, Time division and Wave division, Concepts on spread spectrum.									
UNIT III	DATA LINK LAYER	9							
Fundamentals of Error Detection and Correction, Block coding, Hamming Distance, CRC-Flow Control and Error control protocols - Stop and Wait, Go-back–N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols - Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA									
UNIT IV	NETWORK & TRANSPORT LAYER	9							
Switching, L	Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and								
DHCP–Deliv User Datag Service, Qo	DHCP–Delivery, Forwarding and Unicast Routing protocols. Process to Process Communication, User Datagram Protocol, Transmission Control Protocol, SCTP Congestion Control; Quality of Service, QoS improving techniques - Leaky Bucket and Token Bucket algorithms.								
UNIT V	APPLICATION LAYER	9							
DNS, DDNS,	TELNET, EMAIL, FTP, WWW, HTTP, SNMP, Bluetooth, Firewalls.								
		TOTAL: 45 PERIODS							
TEXTBOOKS):								
1. Tan	enbaum, 'Computer Networks', Pearson Education, 5 th Edition, 20	013.							
2. Will	iam Stallings 'Data and Computer Communications' Pearson Educ	cation India, 2013.							
REFERENCE	BOOKS:								
1. Per Pub	man, R., Kaufman, C., and Speciner, M. 'Network Security: Privalic World' Pearson Education India, 2016.	te Communication in a							
2 (+	ions M/ B. Eonnor B. and Budoff A. M. (UNIX Nativark Dra	gramming' Valuma 1							

2. Stevens, W. R., Fenner, B., and Rudoff, A. M. 'UNIX Network Programming' Volume 1, SMIT-SMU, 2018.

COURSE CODE:	COURSE TITLE:
10212EE106	ARTIFICIAL INTELLIGENCE

3	0	0	3
L	Т	Р	С

COURSE CATEGORY: Specialization

PREAMBLE : This course will make the students to understand, analyse and design an Artificial Intelligence of most advanced fields which involves use of Mathematics, Statistics, Information Technology and Information Sciences in discovering new information and knowledge from large databases and optimize Human effort overall.

PREREQUISITE COURSES: Data Structures and algorithm

COURSE EDUCATIONAL OBJECTIVES :

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

COURSE OUTCOMES :

CO5

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Upon the successful completion of the course, students will be able to:

CO Nos.			Co	ourse Ou		Knowle revised	el (Base s Taxono	d on omy)				
CO1	Inter world	pret app d applic	propriat ation	e search	eal	eal K2						
CO2	Expla first o	in the porder an	various d predio	problen cate logi	methods using			К2	К2			
CO3	Deve repre	Develop the radiate Logic and knowledge K3 representation of solve a given problem										
CO4	Develop the software agents for solving a given problem								ven K3			
CO5	Choo Intell	se app igence.	lication	s for	NLP th	nat use	Artific	cial		К3		
CORRE		I OF CO	5 WITH F	POs ANE) PSOs							
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	РО	8 PO9	PO10	PO11	PO12
CO1	Н	М			L						L	М
CO2	Н	М	М	М	М						L	М
CO3	Н	М			М				L			
CO4	Н	М	L		L						L	М

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COURSE CONTENT :							
UNIT I	INTRODUCTION	9					
Introduction to AI - Problem-Solving Agents - Searching for Solutions- Characteristics of Intellig Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.							
UNIT II	PROBLEM SOLVING METHODS	9					
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constrain Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optima Decisions in Games – Alpha - Beta Pruning - Stochastic Games							
UNIT III	KNOWLEDGE REPRESENTATION	9					
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information							
UNIT IV	SOFTWARE AGENTS	9					
Architecture Argumentat	e for Intelligent Agents – Agent communication – Negotiat ion among Agents – Trust and Reputation in Multi-agent systems	ion and Bargaining – 5.					
UNIT V	APPLICATIONS	9					
Al applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving							
		TOTAL: 45 PERIODS					
TEXTBOOKS	B:						
1. S. F Edit	Russell and P. Norvig, 'Artificial Intelligence: A Modern Appro ion, 2009.	ach' Prentice Hall, 3 rd					
2. l.Br Edu	atko 'Prolog: Programming for Artificial Intelligence', 4 th Ed cational Publishers Inc., 2011.	ition, Addison-Wesley					
REFERENCE	BOOKS:						
1. M. Bart	 M. Tim Jones, 'Artificial Intelligence: A Systems Approach (Computer Science)', Jones and Bartlett Publishers, Inc.; 1st Edition, 2008 						
2. Nils	2. Nils J. Nilsson, 'The Quest for Artificial Intelligence', Cambridge University Press, 2009.						
3. Will Star	 William F. Clocksin and Christopher S. Mellish, 'Programming in Prolog: Using the ISO Standard', 5th Edition, Springer, 2003. 						
4. Ger	hard Weiss, 'Multi Agent Systems', 2 nd Edition, MIT Press, 2013.						

Minor Degree in Electric Vehicle Technology

List of Courses	(18 Credits)
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SI.No	Course Code	Lecture Courses	L	т	Ρ	с
1	10213EE131	Charging Station	3	0	0	3
2	10213EE132	Battery Management System	3	0	0	3
3	10213EE133	Electric Propulsion System and Control	3	0	0	3
4	10213EE134	Hybrid Electric Vehicle Technologies	3	0	0	3
5	10213EE135	Energy Storage Systems and Control	3	0	0	3
6	10213EE136	Modelling and Simulation of EV	2	0	2	3

C	COURS	e code	:	COURSE TITLE:							L	Т	Р	С
	10213	BEE131				CHARG	ING ST	ATION			3	0	0	3
COURSE CATEGORY: MINOR														
PREAM	PREAMBLE: This course focuses on the development of electric vehicle charging stations based on													
conver	ntional	and re	enewab	le ener	gy app	licatior	ns and i	issues a	associa	ted wit	:h integ	gration	•	
PRERE	QUISIT	re cou	RSES:	Basic E	lectrica	al & Ele	ctronic	s Engir	neering					
COURS	SE EDU	ICATIO	NAL OE	SJECTIV	/ES:									
The ob	jective	es of th	e cours	e are t	0,									
•	Intro	duce a	bout ch	arging	statior	ns for e	lectric	vehicle	es.					
•	Impa	irt knov	wledge	about	chargir	ig meti	nodolo	gies an	d grid i	ntegra	tion iss	sues.		
•	Expla			ention	ai and	renewa	able en	ergy ba	ased ch	arging	metho	as.		
Up	on the		s : ssful co	mpleti	on of tl	he cou	rse, stu	Idents	will be	able to):			
				•							К	nowled	lge Lev	el
Nos	5.			(Course	Outco	mes				(В	ased o	n revis	ed
		Jutling	about	FV cha	raina s	tations	cito c	alactio	n issua	s and	Blo	om's T	axonor	ny)
CO	1 C	conor	nic anal	ysis.	i gillg 3	tations	, site s	electio	11 13500	5 8110		К	2	
CO	, E	xplain	about	equip	ment	selectio	on gui	delines	neede	ed to		к	2	
	c	lesign o	charging	g statio	ons.									
COS	3	oumma	rize th	e met whride	hods (of cha	rging (a davic	of elec	ctric v	ehicle		К	2	
		Discuss	about	the	standa	rds ar	nd inte	es. egratio	n issu	es of				
CO4	4 c	hargin	g statio	ns.				0				K	2	
COS	5 E	xplain	about r	enewa	ble en	ergy ba	ised ch	arging	station	s.		K	2	
											I			
CORRE	LATIO	N OF C	Os WIT	'H POs	AND P	SOs								
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М	L			L	М				L	М	М	
CO2	н	М	L			L	М				L	М	М	
CO3	Н	М					М				L	М	М	
CO4	Н	М	L			L	М	L			L	М	М	
CO5	Н	Μ					Μ				L	Μ	Μ	
COURSE CONTENT:														
ι	JNIT I		INTRO	DUCTI	ON							9		
Chargii supply	Charging station overview – equipment specifications - typical site plans – characteristics of EV supply equipment - location selection – siting issues – Methods of reducing installation cost – public													

and private charging stations.

UNIT II	EQUIPMENT SELECTION	9						
Types of chargers - Selection of AC & DC charger - AC & DC pile charger –selection and sizing of distribution transformer – distribution board – HT equipment – HT and LT cables – relay selection – slow charging and fast charging design – difference between slow and fast charger.								
UNIT III	EV CHARGING STRATEGIES	9						
Traditional charging methods: trickle, pulse charging - improvement of CCCV charging - Wireless power Transfer- Far field Strategies: micro wave, laser radiation - Near field strategies: inductive, capacitive, hybrid charging – fast charging - fleet management								
UNIT IV	CHARGING STATION INTEGRATION	9						
Types of EV charging stations – EV charging standards – Levels of charging – Vehicle to Grid (V2G), Vehicle to Home (V2H) technologies and its challenges – Impact of EV on grid – congestion in power lines – Vehicle to Vehicle (V2V) charging – Battery swapping.								
UNIT V	RENEWABLE ENERGY CHARGING	9						
Solar charging for e due to battery cher	lectric vehicles – wind charging stations - power ra nistry and rating – future trends.	ating selection – charging issues						
		TOTAL: 45 PERIODS						
TEXT BOOKS:								
1. Rai G D, 'No	on-Conventional Sources Of Energy', Khanna Publis	shers, 2006.						
2. Kothari P, Technologi	K C Singal and Rakesh Ranjan, 'Renewable I es', PHI Pvt. Ltd., New Delhi, 2008.	Energy Sources and Emerging						
REFERENCE BOOKS	:							
1. Sukhatme S Tata McGra	 Sukhatme S P and Nayak J K, 'Solar Energy - Principles of Thermal Collection and Storage', Tata McGraw Hill, 2008. 							
2. Frank Kreit CRC Press,	 Frank Kreith and Yogi Goswami D, 'Handbook of Energy Efficiency and Renewable Energy', CRC Press, 2007. 							
3. Wakil M M	H, "Power Plant Technology", McGraw Hill, 1984.							
4. <u>https://ww</u>	4. <u>https://www.advanceelectricaldesign.com/Syllabus-EV-Charging-Station-Design-Training</u>							

COU	RSE CODE:	COURSE TITLE:	L	Т	Р	С
102	13EE132	3	0	0	3	
OURSE C	ATEGORY: MINO	3				
PREAMBLI ecycling c	E: This course dea of batteries.	Is with basics of batteries, working principle,	safety s	tandard	s, testir	ng and
REREQUI	SITE COURSES: Ba	asic Electrical & Electronics Engineering				
ELATED (COURSES: EV Batt	eries & Charging System				
COURSE E The object • To re • To • To • To • To	DUCATIONAL OB. Evices of the course learn about the b quirements understand the r know basic conce know about ther understand the c	IECTIVES: e are, basics concepts of Battery Management Syste methods of battery state of charge and health epts and types of cell voltage balancing of bat mal management, safety aspects and standar concepts of battery testing, disposal and recyc	ms (BM estima tery cel ds cling.	S) and it tion ls	t's	
OURSE O Upon 1	UTCOMES : the successful cor	npletion of the course, students will be able t	0:			
CO Nos.		Course Outcomes	k (I Ble	(nowled Based or bom's T	lge Leve n revise axonon	el ed ny)
C01	Identify a BMS i on its application	required for a particular battery type based on		К	2	
CO2	Estimate the remaining charge, voltage, power can be CO2 delivered by a battery, battery health, remaining useful life K3 using various methods K3					
CO3	Solve the problems related to cell voltage balancing in K3					
CO4	Describe the safety aspects and the concept of thermal K2					
CO5	Explain the batt	ery testing methods, disposal and recycling		К	2	

CORRELATION OF COS WITH POS AND PSOS

issues of batteries

COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	Н	М								L	М	Н	L
CO2	н	Н	М								L	М	Н	L
CO3	н	Н	М								L	М	Н	L
CO4	Н	М									L	М	Н	L
CO5	н	М					М				L	М	н	L

COURSE CONTE	NT:						
UNIT I	INTRODUCTION	9					
Introduction - G Battery pack set - thermal contr energy and pow	Introduction - General Battery Management System (BMS) - requirements - functionality -topology - Battery pack sensing: voltage-current-temperature - high voltage contactor control -isolation sensing - thermal control- charge and discharge control - protection and interfacing- range estimation - energy and power estimation.						
UNIT II	STATE OF CHARGE AND STATE OF HEALTH ESTIMATION	9					
Need of State o EMF measurem Battery aging; co	Need of State of Charge (SoC) and State of Health (SoH) estimation; resistive, ampere-hour countin EMF measurement- over potential dependence- Total capacity- Equivalent Series Resistance(ESR) Battery aging; corrosion on positive, negative electrode – power, capacity fading						
UNIT III	CELL BALANCING	9					
Need of cell balancing -causes of imbalance - passive cell balancing- drawbacks – prediction of balance set point- real time balance- capacitor, inductor, transformer, converter, voltage multiplier based active cell balancing techniques – cell bypass, cell to cell, cell to pack, pack to cell balancing, quick balancing.							
UNIT IV	THERMAL MANAGEMENT & SAFETY ASPECTS	9					
Battery therma analysis of cool Voltage Batterie	Battery thermal management - Thermal Runway - Passive cooling - Active cooling- mathematical analysis of cooling system - Causes of battery explosions - regulations and Safety Aspects of High Voltage Batteries - Codes and Standards - Safe handling of Lithium Batteries.						
UNIT V	BATTERY TESTING, DISPOSAL & RECYCLING	9					
Methods of batt and second use short circuits - n	ery testing - selection of battery - limitations of energy storage in of batteries - leakage-rupture - gas generation in batteries - Hi nethods of recycling - General recycling issues .	batteries - disposal gh discharge rates -					
		TOTAL: 45 PERIODS					
TEXT BOOKS:							
 Rahn, Christopher D., and Chao-Yang Wang. 'Battery Systems Engineering'. John Wiley & Sons, 2013. G-A. Nazri and G. Pistoa, 'Lithium Batteries, Science and Technology', Kluwer Academic Publisher, 2003. 							
REFERENCE BOO	DKS:						
1. H. A. Kie	hne, 'Battery Technology Handbook', Marcel Dekker, NYC, 2003.						
2. James L	arminie and John Lowry, 'Electric Vehicle Technology Explained', Jo	ohn Wiley, 2003.					
3. D. Linde	3. D. Linden and T. S. Reddy, 'Handbook of Batteries',' 3 rd Edition, McGraw-Hill, 2002.						
4. D. A. J. I Enginee	4. D. A. J. Rand, R. Woods, and R. M. Dell, 'Batteries for Electric Vehicles', Society of Automotive Engineers, Warrendale, PA, 2003.						
5. Kwade, Way (20	Arno, and Jan Diekmann. 'Recycling of Lithium-Ion batt 18).	eries' The LithoRec					
6. Jiang, Ji Electric	uchun, and Caiping Zhang. 'Fundamentals and Applications of Lith Drive Vehicles'. John Wiley & Sons, 2015.	ium-lon Batteries in					

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE133	ELECTRIC PROPULSION SYSTEM AND CONTROL	3	0	0	3

COURSE CATEGORY: MINOR

PREAMBLE: This course aims in providing a guide to control of both AC and DC motors with a focus on its application to electric vehicle. It provides various field oriented control, Speed control and it also covers PWM techniques & inverters.

PREREQUISITE COURSES: Basic Electrical & Electronics Engineering

RELATED COURSES: Modelling and Simulation Of EV

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Understand the requirement of EV Motors
- Capability to analyze the Induction Motor characteristics and speed control methods
- Impart the knowledge of different types of sensor and their operations.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the requirement of EV motors	К2
CO2	Explain the suitability of electric motor & their control	К2
CO3	Illustrate the speed control of Induction motor	К2
CO4	Outline the PWM techniques of Inverter for Induction motor.	К2
CO5	Summarize different sensors and sensor less operation of motor.	К2

CORRELATION OF COs AND POs

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COURSE CONTENT:										
UNIT I	MOTORS FOR EV AND ITS CHARACTERISTICS	9								
Requirement of EV motors- Comparison of EV motors-Basics of DC Motor-Torque speed										
characteristics- DC N	characteristics- DC Motor dynamics-Field Weakening Control-Four quadrant operation									
UNIT II	DC MOTOR DYNAMICS & CONTROL	9								
Current Loop Contr	ol-Speed Control Loop Dynamical System Control-	Gain & Phase Margins-PD								
Controller-PI Contro	ller-Selecting PI Gain for Speed Controller									
UNIT III	INDUCTION MOTOR	9								
Rotating Magnetic	Field- Basics of Induction motor- Speed & Torque (Curve Leakage inductance-								
current displacemen	t (double cage rotor)- line starting									
UNIT IV	INDUCTION MOTOR SPEED CONTROL	9								
Rotating Magnetic	Field- Basics of Induction motor- Speed-Torque (Curve Leakage inductance-								
current displacemer	nt (double cage rotor)- line starting- Rotor Field ori	ented control- Stator Field								
Oriented Control- Fi	eld Weakening Control- Variable Voltage Variable Free	quency Control								
UNIT V	PWM and Inverter	9								
Sinusoidal PWM- Sp	ace Vector Modulation- Dead time & compensation	- Encoders- Resolvers- R/D								
Converters- Hall cur	rrent sensors and current sampling- Voltage Model	Estimator- Current Model								
Estimator										
		TOTAL: 45 PERIODS								
TEXT BOOKS:										
1 Jameslarmi	nie and John Lowny 'Electric Vehicle Technology Exp	lained' John Wiley & Sons								
2003	ine and some lowly, Electric vehicle recimology exp									
2. Jabal Husain	. 'Electric and Hybrid Vehicles-Design Fundamentals'.	CRC Press. 2003								
	,,	,								
REFERENCE BOOKS:										
1. Mehrdad Eh	1. Mehrdad Ehsani, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press, 2005									
2. K Wang He	e Nam 'AC Motor Control & Electrical Vehicle Appl	ication', CR Press, Taylor&								
Francis Grou	ıp, 2019									
3. C.C Chan, K.	T Chau 'Modern Electric Vehicle Technology', Oxforc	University Press Inc., New								
York 2001.										
CO	URSE CODE:	COURSE TITLE:	L	Т	Р	С				
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10	0213EE134	HYBRID ELECTRIC VEHICLE TECHNOLOGIES	3	0	0	3				
COURSE	CATEGORY: MINO	R		1						
PREAMBLE: This course aims in providing the fundamental knowledge on hybrid electric vehicles, regenerative braking and environmental advantages of electric & hybrid vehicles.										
PREREQUISITE COURSES: Basic Electrical & Electronics Engineering, Basic Mechanical & Construction Engineering										
RELATED COURSES: Modelling and Simulation of EV										
COURSE The obje	EDUCATIONAL OB ctives of the cours	JECTIVES: e are to make the students,								
• /	An overview of the	vehicle propulsion principle								
• /	An understanding o	of the electric vehicles and its power trains								
• -	րիe fundamental k	nowledge on hybrid electric vehicles								
• /	An elaborate know	ledge on regenerative braking								
•	Proad analytical kn	owledge on advantages of electric vehicles on	onviro	nmont						
• [owieuge on advantages of electric venicles on	enviro	innent						
COURSE Upo	OUTCOMES : n the successful co	mpletion of the course, students will be able t	0:							
CO Nos.		Course Outcomes	(Bl	Knowledge Level (Based on revised Bloom's Taxonomy)		el ed ny)				
CO1	Enumerate the p	inciple of vehicle propulsion and braking.		I	<2					
CO2	Explain the struct	ure of an electric vehicle.		ł	<2					
CO3	Illustrate the wor	king principle of a Hybrid Electric Vehicle.		I	<2					
CO4	Identify and solve	the problems in regenerative braking.		I	<3					
CO5	Articulate the e environment.	effects of electric and hybrid vehicles or	n	ł	<2					

CORRELATION OF COS WITH POS AND PSOS

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Н	М	L								L	М	Н	L
Н	М	L								L	М	Н	L
Н	М	L								L	М	Н	L
Н	М	М								L	М	Н	L
Н	М	L								L	М	Н	L
	РО1 Н Н Н	PO1 PO2 H M H M H M H M H M	PO1 PO2 PO3 H M L H M L H M L H M L H M L H M L H M L	PO1 PO2 PO3 PO4 H M L I H M L I H M L I H M L I H M L I H M L I	PO1 PO2 PO3 PO4 PO5 H M L I I H M L I I H M L I I H M L I I H M L I I H M L I I	PO1 PO2 PO3 PO4 PO5 PO6 H M L I I I H M L I I I H M L I I I H M L I I I H M L I I I H M L I I I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 H M L I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 H M L I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 H M L I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 H M L I	PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 H M L I	PO1 PO2 PO3 PO4 PO5 PO6 PO7 PO8 PO9 PO10 PO11 PO12 H M L I I I I M I M H M L I I I I M H M L I I I I I M H M L I I I I I I I H M L I I I I I I I I H M I	PO1PO2PO3PO4PO5PO6PO7PO8PO9PO10PO11PO12PS01HMLIIIIIIIIIIIHMLIIIIIIIIIIIIIIHMILII

COURSE CONTE	:NT:					
UNIT I	FUNDAMENTALS OF VEHICLE PROPULSION	9				
General Descri Tractive Effort Performance- C	otion of Vehicle Movement- Vehicle Resistance- Dynamics of Vehicle Speed- Vehicle Power Plant and Transmiss operating Fuel Economy- Brake Performance	mic Equation- Power Train, sion Characteristics- Vehicle				
UNIT II	ELECTRIC VEHICLE& PROPULSION SYSTEMS	9				
Configurations Transmission F Consumption- Permanent Mag	of EVs- Performance of EVs- Traction Motor Characte Requirement- Vehicle Performance- Tractive Effort i Principle of Operation and Performance-DC Motor Driv gnet BLDC Motor Drives-SRM Drives	eristics- Tractive Effort and n Normal Driving- Energy /es-Induction Motor Drives-				
UNIT III HYBRID ELECTRIC VEHICLES 9						
HEV-Types of HEVs-Series & Parallel HEVs-Advantages & Disadvantages-Series-Parallel Combination Design of an HEV-Hybrid Drivetrains-sizing of components-rated vehicle velocity						
UNIT IV	REGENERATIVE BRAKING	9				
Braking Energy	Consumed in Urban Driving- Braking Energy versus Ver	hicle Speed- Braking Energy				
Braking Energy versus Braking Deceleration R Parallel Hybrid	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System	hicle Speed- Braking Energy king Energy versus Vehicle rstem of EV, HEV, and FCV-				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT	hicle Speed- Braking Energy king Energy versus Vehicle rstem of EV, HEV, and FCV- 9				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicle	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Usin	hicle Speed- Braking Energy king Energy versus Vehicle estem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicle	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Usin	hicle Speed- Braking Energy king Energy versus Vehicle estem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with TOTAL: 45 PERIODS				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicle TEXT BOOKS:	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Usin	hicle Speed- Braking Energy king Energy versus Vehicle rstem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with TOTAL: 45 PERIODS				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicles TEXT BOOKS: 1. Husain 2. Larmini Ltd, 200	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Using I. 'Electric and Hybrid Vehicles: Design Fundamentals'. CR e, James, and John Lowry. 'Electric Vehicle Technology Ex 3.	hicle Speed- Braking Energy king Energy versus Vehicle stem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with TOTAL: 45 PERIODS C Press; 2011. kplained' John Wiley & Sons,				
Braking Energy versus Braking Deceleration R Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicles TEXT BOOKS: 1. Husain 2. Larmini Ltd, 200 REFERENCE BO	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Using I. 'Electric and Hybrid Vehicles: Design Fundamentals'. CR e, James, and John Lowry. 'Electric Vehicle Technology Exo 3. DKS:	hicle Speed- Braking Energy king Energy versus Vehicle estem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with TOTAL: 45 PERIODS C Press; 2011. kplained' John Wiley & Sons,				
Braking Energy versus Braking Deceleration Ri Parallel Hybrid UNIT V Vehicle Pollutio Context- Alterr Fuelled Vehicles TEXT BOOKS: 1. Husain 2. Larmini Ltd, 200 REFERENCE BO 1. Ehsani, Vehicle 2. Emadi,	Consumed in Urban Driving- Braking Energy versus Vel Power- Braking Energy versus Braking Power- Brak ate- Braking Energy on Front and Rear Axles- Brake Sy Braking System- Fully Controllable Hybrid Brake System ELECTRIC VEHICLES & ENVIRONMENT on: the Effects- Vehicles Pollution: a Quantitative An native and Sustainable Energy Used via the Grid- Using I. 'Electric and Hybrid Vehicles: Design Fundamentals'. CR e, James, and John Lowry. 'Electric Vehicle Technology Ex 03. DKS: Mehrdad, YiminGao, and Ali Emadi. 'Modern Electric, H s: Fundamentals, Theory, and Design'. CRC Press, 2009. Ali, 'Handbook of Automotive Power Electronics and Mot	hicle Speed- Braking Energy king Energy versus Vehicle rstem of EV, HEV, and FCV- 9 halysis- Vehicle Pollution in ng Sustainable Energy with TOTAL: 45 PERIODS C Press; 2011. Kplained' John Wiley & Sons, Hybrid Electric, and Fuel Cell or Drives' CRC Press, 2005.				

COURS	SE CODE:	COURSE TITLE:	L	Т	Р	С				
1021	3EE135	ENERGY STORAGE SYSTEMS AND CONTROL	3	0	0	3				
COURSE	CATEGORY: N	AINOR	•		1	L				
PREAMB Battery C	LE: This cour haracteristics	se aims in providing the fundamental knowledge of , Battery modelling, Battery testing and Battery Mar	on Energ nagemer	gy Stora It syster	nge sys m.	tem,				
PREREQUISITE COURSES: Basic Electrical & Electronics Engineering										
RELATED COURSES: Battery Management System										
COURSE	EDUCATIONA	AL OBJECTIVES:								
The object	ctives of the o	course are to,								
• P	rovide the ba	sic concepts of Energy Storage systems								
• Ir	mpart fundan	nental knowledge on battery characteristics & param	neters							
• U	Inderstand ov	verview of different types of battery								
• U	Inderstand th	e battery testing, disposal and recycling.								
COURSE	OUTCOMES :									
Upon	the successf	ul completion of the course, students will be able to	:							
CO Nos.		Course Outcomes	Knowledge Level (Bas on revised Bloom's Taxonomy)		ed ;					
C01	Discuss abo	ut the types of energy storage system.		K2						
CO2	Describe ab	out the battery characteristic & parameters.		K2						
CO3	Apply the concepts of battery management system and K3 K3									
CO4	Summarize	the different types of batteries.		K2						
CO5	Explain abo	ut the battery testing, disposal and recycling.		K2						

CORRELATION OF COS WITH POS AND PSOS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Н	М	L								L	М	Н	L
CO2	Н	М	L								L	М	Н	L
CO3	Н	М	М								L	М	Н	L
CO4	Н	М	L								L	М	Н	L
CO5	Н	М	L				L				L	М	Н	L

COURSE CONT	ENT:	
UNIT I	ENERGY STORAGE SYSTEM	9
Batteries: Lead	Acid Batter- Nickel based batteries- Sodium based batteries- Lit	hium based batteries-
Li-ion &Li-poly	/- Metal Air Battery-Zinc Chloride battery- Ultra capacitors- Fly	wheel Energy Storage
System- Hydra	ulic Energy Storage System- Comparison of different Energy Stor	age System Suggested
reading: Study	of different types of batteries	
UNIT II	BATTERY CHARACTERISTICS & PARAMETERS	9
Cells and Bat	teries- conversion of chemical energy to electrical energy- I	Battery Specifications:
Variables to o	characterize battery operating conditions and Specifications to	o characterize battery
nominal and n	naximum characteristics- Efficiency of batteries- Electrical param	eters Heat generation-
Battery design	-Performance criteria for Electric vehicles batteries- Vehicle pro	pulsion factors- Power
and energy ree	quirements of batteries- Meeting battery performance criteria	l
UNIT III	BATTERY MODELLING	9
General appro	pach to modelling batteries- Model of a rechargeable Li-ion	n battery-Model of a
rechargeable I	NiCd battery- Parameterization of the NiCd battery model	Γ
UNIT IV	BATTERY PACK AND BATTERY MANAGEMENT SYSTEM	9
Selection of	battery for EVs & HEVs- Traction Battery Pack design-Red	quirement of Battery
Monitoring		
UNIT V	BATTERY TESTING, DISPOSAL & RECYCLING	9
Chemical & s	structure material properties for cell safety and battery de	sign- battery testing-
limitations for	transport and storage of cells and batteries- Recycling- dispo	sal and second use of
batteries- Gen	eral recycling issues -Methods of recycling of EV batteries	
		TOTAL: 45 PERIODS
TEXT BOOKS:		
1. Ibrahin Batter	m Dinçer, Halil S. Hamut and Nader Javani, 'Thermal Managem y Systems', John Wiley& Sons Ltd., 2016.	ent of Electric Vehicle
2. Chris	Mi, AbulMasrur & David Wenzhong Gao, 'Hybrid Electri	c Vehicle- Principles
& App	lications with Practical Properties', Wiley, 2011.	
REFERENCE BO	DOKS:	
1. James 2003.	Larminie, John Lowry, 'Electric Vehicle Technology Explained',	John Wiley &Sons Ltd,
2. G. P Elsevie	istoia, J.P. Wiaux, S.P. Wolsky, 'Used Battery Collect er, 2001. (ISBN: 0-444-50562-8)	ion and Recycling',
3. T R (Profes	Crompton, 'Battery Reference Book', 3 rd Edition, Newnes R sional Publishing Ltd., 2000.	eed Educational and

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE136	MODELLING AND SIMULATION OF EV	2	0	2	3

COURSE CATEGORY: MINOR

PREAMBLE: This course aims in providing the Knowledge on Modelling and Simulation level of Electric Vehicle.

PREREQUISITE COURSES: Basic Electrical & Electronics Engineering

RELATED COURSES: Hybrid Electric Vehicle Technologies, Battery Management System

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to,

- Impart fundamental knowledge on technical parameters of batteries, battery charger, types of fuel cells.
- Impart analytical knowledge on modelling and Simulation of Hybrid Electric Vehicle

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Elaborate various technical parameters of batteries	К2
CO2	Compare types of batteries used for EV applications.	К2
CO3	Develop battery charger for an EV	КЗ
CO4	Interpret the applications of super capacitors for appropriate storage systems.	К2
CO5	Classify the types of fuel cells	К2

CORRELATION OF COS WITH POS AND PSOs

CO1 H M L M M M H CO2 H H M L M M M H CO2 H H M L M M H M H	М			. •	POID	P09	P08	PO7	PO6	PO5	PO4	PO3	PO2	PO1	COs
CO2 H H M L M M H	141	Н	М	М						М	L	М	Н	Н	CO1
	Μ	Н	М	М						М	L	М	Н	Н	CO2
	Μ	Н	М	М							L	М	Н	Н	CO3
CO4 H H M L L M M H	Μ	Н	М	М						L	L	М	Н	Н	CO4
CO5 H M L M M H	Μ	Н	М	М								L	М	Н	CO5

COURSE CON	TENT:						
UNIT I	MODELLING OF VEHICLE PERFORMANCE PARAMETER	6					
Modeling Veh an electric sco	icle Acceleration - Acceleration performance parameters- mod poter- modeling the acceleration of a small car.	eling the acceleration of					
UNIT II	MODELLING AND SIMULATION OF HYBRID AND ELECTRIC VEHICLES	15					
Electric Vehicle Modelling - Tractive Effort- Rolling resistance force- Aerodynamic drag- Hill climbing force- Acceleration force- Total tractive effort- Modelling Electric Vehicle Range -Driving cycles-Range modelling of battery electric vehicles- Constant velocity range modelling-Range modelling of fuel cell vehicles- Range of Electric vehicles.							
UNIT III	DRIVETRAIN CHARACTERISTICS	15					
Modelling and Characteristics of EV Power trains Components - Electric Motor Performance Characteristics - Battery Performance Characteristics-Transmission and Drive train Characteristics							
UNIT IV	UNIT IV ENERGY MANAGEMENT						
Handling Analysis of Electric Vehicles- Simplified Handling Models Energy/Power Allocation and Management - Power/Energy Management Controllers – Rule Based Control Strategies - Optimization-Based Control Strategies Simulation study – Energy Management control of electric vehicles.							
UNIT V	FUEL CELLS	9					
Control of Ele Implementation Powered Bus.	ctric Vehicle Dynamics - Fundamentals of Vehicle Dynamic Cor on on Electric Vehicles – Case Studies- Rechargeable Batte	ntrol (VDC) Systems-VDC ry vehicles, Fuel Cell					
		TOTAL: 60 PERIODS					
TEXT BOOKS:							
1. Amir Techn	Khajepour, Saber Fallah and Avesta Goodarzi, 'Electric ologies, Modelling and Control: A Mechatronic Approach', Johr	and Hybrid Vehicles Wiley &Sons Ltd, 2014.					
2. Antor Mode	ii Szumanowski, 'Hybrid Electric Power Train Enginee Iling, Control, and Simulation', IGI Global, 2013	ring and Technology:					
REFERENCE B	OOKS:						
1. Mehr Cell V	dadEhsani, YiminGao, Ali Emadi, 'Modern Electric, Hyb ehicles Fundamentals, Theory, and Design', 2 nd Edition, CRC Pre	rid Electric, and Fuel ss, 2010.					
2. James 2003.	S Larminie, John Lowry, 'Electric Vehicle Technology Explained	', John Wiley &Sons Ltd,					

Minor Degree in Renewable Energy Sources

List of Courses	(18 Cred	lits)
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S.No.	Course Code	Lecture Courses	L	т	Р	С
1	10213EE141	Renewable Energy	3	0	0	3
2	10213EE142	Wind Energy Conversion Systems	3	0	0	3
3	10213EE143	Solar Photovoltaics: Fundamentals, Technology and Applications	3	0	0	3
4	10213EE144	Conversion of Energy in Buildings	3	0	0	3
5	10213EE145	Solar Thermal Energy Systems	3	0	0	3
6	10213EE146	Distributed Generation and Integration of Renewable Energy with Grid	3	0	0	3

COURSE CODE:	COURSE TITLE:	L	Т	Р	С
10213EE141	RENEWABLE ENERGY	3	0	0	3

COURSE CATEGORY: MINOR

PREAMBLE: This course focuses on the new renewable energy based electric energy generation technologies and their integration into the power grid. The principals of new energy based distributed generation technologies: solar, wind, and fuel cells.

PREREQUISITE COURSES: Basic Electrical & Electronics Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- Introduce about the renewable energy sources like wind, solar and wave energy.
- Impart knowledge about the environmental friendly energy production and consumption.
- Explain about energy-efficient systems and products for various applications.

COURSE OUTCOMES :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain about Renewable Energy resources and its importance.	К2
CO2	Outline the process of photovoltaic power generation.	К2
CO3	Outline the process of power generation using wind energy sources.	К2
CO4	Biomass and biogas production techniques.	К2
CO5	Explain the fundamentals and applications of Geothermal energy, tidal energy, MHD and fuel cells.	К2

CORRELATION OF COS WITH POS AND PSOS

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											L	L
CO2		Н	Н					Μ	Μ			
CO3		н										
CO4			Н		Н	L	Н				L	L
CO5		L			L			М	М		L	L
ι												

COURSE CONTEN	T:	
UNIT I	INTRODUCTION	9
World energy us energy utilization	e-reserves of energy resources-energy cycle of the earth-envi -renewable energy resources and their importance.	ironmental aspects of
UNIT II	SOLAR ENERGY	9
Basic concepts, heliostats, heat t state principles, s	solar thermal systems and solar ponds, solar thermal cent ransport system, thermal storage systems, photovoltaic ener emi-conductors, solar cell, batteries, satellite solar power syster	ral receiver systems, gy conversion, solid - ns.
UNIT III	WIND ENERGY	9
Principles of winc new developmen systems.	l power, wind turbine operation, site characteristics, horizontal a ts, small and large machines, magnus effect, design principles of	and vertical axis types, wind turbine, storage
UNIT IV	BIOMASS AND BIOGAS	9
Concepts and sys biomass resource environmental fa liquefaction, mod wet processes, ch	tems, biomass production, energy plantation, short rotation spe agro-forestry wastes, municipal solid wastes and agro processi actors and biomass energy development, combustion, pyrol deling, appliances and latest development, bioconversion: biog emicals from biomass and biotechnology.	ecies, forestry system, ng industrial residues, lysis, gasification and gas, fermentation and
UNIT V	OTHER RENEWABLE ENERGY SOURCES	9
Geothermal ener applications. W applications. Mag technologies. Mic	rgy, types, systems and application, Ocean thermal energy, ave energy - types, systems and applications. Tidal energy gneto Hydrodynamic system (MHD). Fuel cells – types and a ro-hydel systems. Hybrid systems and applications.	, types, systems and - types, systems and pplications, hydrogen
		TOTAL: 45 PERIODS
TEXT BOOKS:		
1. Rai G D, '	Non-Conventional Sources of Energy', Khanna Publishers, 2006	
2. Sukhatme McGraw	e S P and Nayak J K, 'Solar Energy - Principles of Thermal Collect Hill, 2008.	ion and Storage', Tata
REFERENCE BOOI	<s:< td=""><td></td></s:<>	
1. Kothari I Technolo	P, K C Singal and Rakesh Ranjan, 'Renewable Energy Sc gies', PHI Pvt. Ltd., New Delhi, 2008.	ources and Emerging
2. Frank Kre Press, 200	ith and Yogi Goswami D, 'Handbook of Energy Efficiency and Re)7.	enewable Energy', CRC
 Abbasi S PHI Privat 	A and Naseema Abbasi, 'Renewable Energy Sources and their E e Limited, 2001.	nvironmental Impact',
4. Wakil M I	M H, 'Power Plant Technology', McGraw Hill, 1984.	

COURSE C	CODE:	COURSE TITLE:		L	Т	Ρ	С
10213EE	142	WIND ENERGY CONVERSION SYSTEMS	:	3	0	0	3
COURSE CATE	EGORY: MII	NOR					
PREAMBLE: V	Wind energ	y is the fast-growing renewable source for elect	tricity ge	ene	ration.	This o	course
presents a bro	oad overvie	ew of wind energy technology.					
PREREQUISIT	E COURSES	Basic Electrical Engineering					
COURSE EDU	CATIONAL	OBJECTIVES:					
 To lear 	arn about P	ower extraction from wind energy					
To dis	stinguish th	e components and design of wind tower					
• To un	derstand w	vorking principle of induction generator, synchron	ous gene	erat	or		
COURSE OUT	COMES:						
Upon the	successful	completion of the course, students will be able to):				
СО		Course Outcomes	Knowle	dge	e Level	(Base	d on
Nos.		Course Outcomes	revised	Blo	om's 1	Faxono	omy)
CO1	Fundame	ntals of wind energy conversion			К2		
CO2	Types of v	vind turbines and aerodynamics			К2		
CO3	Compone	nts of wind turbine and its construction			К2		
CO4	Explain th	e principle of operation of Types of generators			К2		
CO5	Wind turb	pine control and monitoring system			К2		

CORRELATION OF COS WITH POS AND PSOS

cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L				L				L	М		
CO2	L								L	М		
CO3	Н		Н					М	L	М		
CO4	L							М	М	М		
CO5	L		М		М			Н	М	М		

COURSE CONTENT:

UNIT I

WIND ENERGY FUNDAMENTALS AND MEASUREMENTS

9

Wind energy basics - Wind speed and scales - Terrain-Roughness-Wind mechanics - Power content – Class of wind turbine- Atmospheric boundary layers-Turbulence. Instrumentation for wind measurements - Wind data analysis - tabulation. Wind resource estimation - Betz's limit-Turbulence analysis.

UNIT II	WIND TURBINE AREODYNAMICS AND TYPES	9
Airfoil terr technique generator	ninology - Blade element theory - Blade design -Rotor performance and dyr (Rotor &Blade)-Types of loads - Source of loads - Up wind-Down winc type - Direct generator drive/PMG/Rotor excited sync generator.	namics- Balancing d - Gear coupled
UNIT III	GEAR COUPLED GENERATOR WIND TURBINE COMPONENTS AND THEIR CONSTRUCTION	9
Electronic synchronis Compensa circuits - Battery/Su Suppresso	sensors /Encode /Resolvers - Wind measurement: anemometer & wation system - Soft starter - Switchgear [ACB/VCB]-Transformer - Cables tion panel - Programmable logic control – UPS - Yaw & pitch system: AC dri Generator rotor resistor controller(Flexi slip) - Differential protection rela per capacitor charger & Batteries/Super capacitor for pitch r/Lightning arrestors - Oscillation & Vibration sensing.	vind vane - Grid s and assembly - ves - Safety chain y for generator - system-Transient
UNIT IV	DIRECT ROTOR COUPLED GENERATOR (MULTIPOLE)[VARIABLE SPEED -VARIABLE FREQUENCY]	9
Excited ro converter current) -	tor synch. Generator/PMG generator - Control rectifier-Capacitor banks (DC-DC Step Up) - Grid tied inverter - Power management - Grid monitoring Transformer - Safety chain circuits.	 Step up/Boost unit (Voltage and
UNIT V	MODERN WIND TURBINE CONTROL & MONITORING SYSTEM	9
Details of Wind turb reports - 0 control &	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes.	in wind turbine- g and generation & Blade) - FACTS
Details of Wind turb reports - (control &	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS
Details of Wind turb reports - (control & TEXTBOO	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS
Details of Wind turb reports - (control & TEXTBOO 1. V TE	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC SS: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008.	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium',
Details of Wind turb reports - (control & TEXTBOOI 1. V\ TE 2. M	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitoring operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC SS: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008. artin OL Hansen 'Aerodynamics of Wind Turbines', 2 nd Edition, Earthscan, Lor	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium', ndon.
Details of Wind turb reports - (control & TEXTBOOI 1. VV TE 2. M 3. B.	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin Operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC SS: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008. artin OL Hansen 'Aerodynamics of Wind Turbines', 2 nd Edition, Earthscan, Lor 1.Khan: Non-Conventional Energy Sources, Tata McGraw-Hill Education, 200	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium', ndon. 6.
Details of Wind turb reports - (control & TEXTBOOK 1. VV TE 2. M 3. B. REFERENC	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin Operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC SS: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008. artin OL Hansen 'Aerodynamics of Wind Turbines', 2 nd Edition, Earthscan, Lor H.Khan: Non-Conventional Energy Sources, Tata McGraw-Hill Education, 200 E BOOKS:	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium', ndon. 6.
Details of Wind turb reports - (control & TEXTBOOI 1. VV TE 2. M 3. B. REFERENC 1. Jo	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC S: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008. artin OL Hansen 'Aerodynamics of Wind Turbines', 2 nd Edition, Earthscan, Lor H.Khan: Non-Conventional Energy Sources, Tata McGraw-Hill Education, 200 E BOOKS: nnson, G.L., 'Wind Energy Systems', Prentice Hall, 1985.	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium', ndon. 6.
Details of Wind turb reports - (control & TEXTBOOI 1. VV TE 2. M 3. B. REFERENC 1. Jo 2. Pa 20	pitch system &Control algorithms-Protections used & Safety consideration ine monitoring with error codes - SCADA & Databases: remote monitorin operation & Maintenance for product lifecycle - Balancing technique (Rotor VRT & New trends for new grid codes. TC S: N Kishore 'Renewable Energy Engineering and Technology – A Knowledg RI Press, 2008. artin OL Hansen 'Aerodynamics of Wind Turbines', 2 nd Edition, Earthscan, Lor H.Khan: Non-Conventional Energy Sources, Tata McGraw-Hill Education, 200 E BOOKS: nnson, G.L., 'Wind Energy Systems', Prentice Hall, 1985. ul Gipe 'Wind Energy Basics: A Guide to Small and Micro Wind', Chelsea (08.	in wind turbine- g and generation & Blade) - FACTS DTAL: 45 PERIODS ge Compendium', ndon. 6. Green Publishing,

COURSE	CODE:

COURSE TITLE:

10213EE143 SOLA

SOLAR PHOTOVOLTAICS: FUNDAMENTALS, TECHNOLOGY AND APPLICATIONS

L T P C 2 0 2 3

COURSE CATEGORY: Minor Degree Course

PREAMBLE: This course offer a basic knowledge on solar Photovoltaic technology and Systems comprising up of the fundamentals, design and application of solar photovoltaic systems for power generation on small and large scale electrification.

PRE-REQUISITES: Basic Electrical Engineering

COURSE EDUCATIONAL OBJECTIVES:

To impart knowledge on

- To familiar with basics of solar PV
- To familiar with various PV performance measure terminologies.
- To understand about manufacturing of PV cells & sizing aspects of PV systems.
- To understand about PV system components and apply them in installation practices& associated trouble shootings.
- To understand about PV system applications & associated safety measures

COURSE OUTCOMES:

Upon the completion of the course students will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the principle of direct solar energy conversion to power using PV	К2
CO2	Contrast the performance measures of PV	К2
CO3	Infer on various solar cells & design aspects of solarPV	К2
CO4	Identify various PV components & construct few systems	К2
CO5	Develop ideas for working on solar PV systems & associated safety practices	К2

CORRELATION OF COs AND POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	н									н		
CO2	н	М	М							н		Н
CO3	Н			Н						н		Н
CO4	н	М		н						н		
CO5	Н									Н		

COURSE CONTENT	S	
UNIT I	SOLAR CELL FUNDAMENTALS	6
Principle of solar e basic equations. So	energy conversion, Photovoltaic effect, Semiconductor properties, plar cell structure, parameters of solar cell.	, energy levels,
UNIT II	PV MODULE PERFORMANCE	6
Solar PV modu combination, cell e solar cell.	les & arrays, I-V &P-V characteristics, maximum power point, efficiency, fill factor, role of bypass & blocking diode, factors affect	series parallel ing output of a
UNIT III	MANUFACTURING OF PV CELLS & DESIGN OF PV SYSTEMS	6
Commercial solar of cells, amorphous s PV systems, cost est	cells - Production process of single crystalline silicon cells, multi cr ilicon, cadmium telluride, copper indium gallium diselenide cells. stimation, various aspects, system simulation tools.	ystalline silicon Design of solar
UNIT IV	SOLAR PV SYSTEMS INSTALLATIONS & TROUBLE SHOOTING	6
Classification - Cer Interactive PV Syst solar photovoltaic metering, PV arr components.	ntral Power Station System, Distributed PV System, Stand-alone F em, small system for consumer applications, hybrid solar PV system . System components - PV arrays, inverters, batteries, charge of ay installation, operation, costs, reliability. Troubleshooting	V system, grid n, concentrator controllers, net of PV system
UNIT V	PV SYSTEM APPLICATIONS & SAFETY	6
Building-integrated for distributed po challenges, Applica satellites. Socio-ec solar PV systems	d photovoltaic units, grid connected central power stations, stand ower supply in remote and rural areas, Outlook for the Indian ations: solar home system, solar cars, Solar Charger, aircraft, spa onomic and environmental merits of photovoltaic systems safety in	J-alone devices PV industry& ce solar power n Installation of
	тот	AL: 30 PERIODS
TEXTBOOKS:		
 Chetan Sin Learning P¹ 	gh Solanki., 'Solar Photovoltaic: Fundamentals, Technologies and A vt., Ltd., 2009.	pplication', PHI
2. Jha A.R., 'S	olar Cell Technology and Applications', CRC Press, 2010.	
REFERENCE BOOKS	S:	
1. Chetan Sin	gh Solanki 'Solar PV technology and system', PHI learning private lir	nited, 2015.
2. Luque A. L.	and Andreev V.M., 'Concentrator Photovoltaic', Springer, 2007.	
3. Partain L.D	., Fraas L.M., 'Solar Cells and Their Applications', 2 nd Edition, Wiley,	2010.
	ACTICES (15 PERIODS)	
1) To perform expe	eriment to study I-V characteristics of SPV module.	
2) To perform expe	eriment to study series combination of SPV modules.	
3) To perform expe	eriment to study parallel combination of SPV modules.	

4) To perform experiment to study effect of tilt angle on SPV module output.

5) To perform experiment to demonstrate the effect of shading on SPV module output.

6) To study the effect of shading on the output of solar panel.

8) To understand how to use various electrical measuring equipments.

WEB REFERENCES:

<u>https://www.nrel.gov</u> The *National Renewable Energy Laboratory* (*NREL*), located in Golden, Colorado, specializes in renewable energy and energy efficiency research and development. *NREL* is a government-owned, contractor-operated facility, and is funded through the United States Department of Energy.

<u>https://nise.res.in/</u> National Institute of Solar Energy, an autonomous institution of Ministry of New and Renewable (MNRE), is the apex National R&D institution in the field Solar Energy. The Government of India

<u>http://www.seriius.org/</u> (SERIIUS—the Solar Energy Research Institute for India and the United States—is co-led by the <u>Indian Institute of Science (IISc)—Bangalore</u>, India, and the <u>National</u> <u>Renewable Energy Laboratory (NREL)</u>, Golden, Colorado, USA.)

	RSE CODE:			CO	URSE TI	TLE:			L	T F	C C	
102	213EE144	C	ONSER	VATION	OF ENEF	RGY IN B	UILDING	iS	3	0 0	3	
COURSE C	ATEGORY: MI	NOR										
PREAMBL energy co conservat	E: The main on servation con ion act.	bjective cepts in	of this building	course i s by lea	is to ma rning the	ke the s e design	students of ener	to und gy efficio	erstand ent build	the con lings and	cepts c l energ	
PREREQU	ISITE COURSES	: Nil										
COURSE E	DUCATIONAL	OBJECTI	/ES:									
The objec	tives of the cou	irse are t	o make	the stud	lents,							
• In	troduction to e	energy co	onservat	ion tech	nology							
• E×	plain in detail a	about wa	aste hea	t recove	ry syster	n						
• Er	nergy efficiency	, improve	ement ir	n buildin	gs							
• Di	iscuss in detail	about er	ergy co	nservatio	on act.							
• Re	enewable energ	gy gener	ation in	building	s.							
COURSE C	OUTCOMES:											
Upon	the successful	completi	on of th	e course	e, studer	nts will b	e able to):				
CO Nos.			Course	Outcon	nes			Knov revis	owledge Level (Based on ised Bloom's Taxonomy)			
CO1		rev							K2			
COI	Introduction to energy conservation technology								l	K2	nomy)	
CO1	Explain in de	to ener	gy conse ut waste	ervation heat re	technolo covery s	ogy ystem				K2 K2	nomy)	
CO1 CO2 CO3	Explain in de Energy effici	to ener etail abor iency im	gy conse ut waste proveme	ervation heat re ent in bu	technolo covery s iildings	ogy ystem				K2 K2 K2	nomy)	
CO1 CO2 CO3 CO4	Introduction Explain in de Energy effici Discuss in de	n to ener etail abor iency imp etail abo	gy conse ut waste proveme ut energ	ervation heat re ent in bu gy conse	technolo covery s iildings rvation a	ogy ystem act.				K2 K2 K2 K2	nomy)	
CO2 CO3 CO4 CO5	Introduction Explain in de Energy effici Discuss in de Renewable	n to ener etail abo iency imp etail abo energy g	gy conse ut waste proveme ut energ eneratic	ervation e heat re ent in bu gy conse on in buil	technolo covery s iildings rvation a ldings.	ogy ystem act.				K2 K2 K2 K2 K2 K2		
CO2 CO3 CO4 CO5	Introduction Explain in de Energy effici Discuss in de Renewable o	n to ener etail abo iency im etail abo energy g ND POs	gy conse ut waste proveme ut energ eneratic	ervation e heat re ent in bu gy conse on in buil	technolo covery s ildings rvation a ldings.	ogy ystem act.				K2 K2 K2 K2 K2 K2		
CO2 CO3 CO4 CO5 CORRELAT	Introduction Explain in de Energy effici Discuss in de Renewable TION OF COs A PO1	n to ener etail abou iency im etail abo energy g ND POs PO3	gy conse ut waste proveme ut energ eneratic PO4	ervation e heat re ent in bu gy conse on in buil	technolo covery s iildings rvation a ldings. PO6	pgy ystem act. PO7	PO8	PO9	P010	<pre>K2 K2 K2 K2 K2 K2 K2 F011</pre>	PO12	
CO2 CO3 CO4 CO5 CORRELAT COs CO1	Introduction Explain in de Energy effici Discuss in de Renewable TION OF COs A P01 P02	n to ener etail abo iency im etail abo energy g ND POs PO3	gy conse ut waste proveme ut energ eneratic PO4	ervation e heat re ent in bu gy conse on in buil PO5	technolo covery s iildings rvation a ldings. PO6	pgy ystem act. PO7	P08	P09	P010	<pre>K2 K2 K2 K2 K2 K2 K2 F011 L</pre>	PO12	
CO2 CO3 CO4 CO5 CORRELAT COs CO1 CO2	Introduction Explain in de Energy effici Discuss in de Renewable of FION OF COs A PO1 PO2 H	n to ener etail abou etail abou etail abou energy g ND POs PO3 H	gy conse ut waste proveme ut energ eneratic PO4	ervation e heat re ent in bu gy conse on in buil PO5	technolo covery s iildings rvation a ldings.	pgy ystem hct. PO7	P08	P09	P010	<pre>K2 K2 K2 K2 K2 K2 F011 L</pre>	PO12	
CO2 CO3 CO4 CO5 CORRELAT COs CO1 CO2 CO3	Introduction Explain in de Energy effici Discuss in de Renewable of FION OF COS A PO1 PO2 H H	n to ener etail abor iency im etail abo energy g ND POs PO3 H	gy conse ut waste proveme ut energ eneratic PO4	ervation e heat re ent in bu gy conse on in buil PO5	technolo covery s iildings rvation a ldings.	pgy ystem ect. PO7	PO8	P09	PO10	K2 K2 K2 K2 FO11 L	PO12	
CO2 CO3 CO4 CO5 CORRELAT COs CO1 CO2 CO3 CO4	Introduction Explain in de Energy effici Discuss in de Renewable of FION OF COS A PO1 PO2 H H	n to ener etail abor iency im etail abor energy g ND POs PO3 H	gy conse ut waste proveme ut energ eneratic PO4	ervation e heat re ent in bu gy conse on in buil PO5	technolo covery s iildings rvation a ldings. PO6	pgy ystem act. PO7	PO8	P09	PO10	K2 K2 K2 K2 K2 PO11 L	PO12	

COURSE CONTENT:

UNIT I	GENERAL ASPECTS	9
Introduction, A	pproach and modern techniques, benefits, trends, Energy Conservat	tion Technology,
Energy Conserv	vation in Energy Intensive Industries, Techno-Economic evaluation	of conservation
technologies, Eff	ficiency Improvements Thermal Utilities, Heating and Melting Applications	s, Refractories.

UNIT II	WASTE HEAT RECOVERY	9
Sources of was	ste heat and its potential applications, Waste heat survey and mea	surements, Data
collection, Limi	tations and affecting factors Heat recovery equipment and systems, H	Heat Exchangers,
Incinerators Reg	generators and Recuperates, system Integration.	
UNIT III	ENERGY EFFICIENCY IN BUILDINGS	9
Adoption to sus	tainable resources, process and Technologies, Green Buildings, Intelligent	Buildings, Rating
of Buildings, Eff	icient Use of Buildings, Solar Passive Architecture, Eco-housing concepts	and National and
International no	rms.	
UNIT IV	ENERGY CONSERVATION & ACT	9
Energy conserva	ation act 2001, salient features, Ministry of New and Renewable Energy ((MNRE), National
Product Counci Building Code)-2	l (NPC), Bureau of Energy Efficiency (BEE), Net metering, ECBC (Ener 2017.	rgy Conservation
UNIT V	RENEWABLE ENERGY GENERATION IN BUILDINGS	9
Model of solar	power plant, wind power plant, energy consumption calculation in bui	ildings, design of
energy efficient requirements, s	solar buildings, design of grid connected renewable energy sources election of renewable energy sources based on location.	, energy storage
	то	TAL: 45 PERIODS
TEXT BOOKS:		
1. Rai G D,	'Non-Conventional Sources of Energy', Khanna Publishers, 2006.	
2. Sukhatn	ne S P and Nayak J K, 'Solar Energy - Principles of Thermal Collection a	nd Storage', Tata
McGrav	/ Hill, 2008.	
REFERENCE BOO	DKS:	
1. Kothari	P, K C Singal and Rakesh Ranjan, 'Renewable Energy Sources and Emergi	ng Technologies',
PHI Pvt	. Ltd., New Delhi, 2008.	
2. L.C. Wit	te, P.S. Schmidt, D.R. Brown, 'Industrial Energy Management and Utilisat	ion', Hemisphere
Publica	ition, Washington.	
3. Energy	Conservation guide book Patrick/Patrick/Fardo (Prentice Hall)	
4. Abbasi S Private	S A and Naseema Abbasi, 'Renewable Energy Sources and their Environme Limited, 2001.	ental Impact', PHI

COL	JRSE CODE:	COURSE TITLE:	L	Т	Р	C
10	213EE145	SOLAR THERMAL ENERGY SYSTEMS	3	0	3	
COURSE	CATEGORY: MINOI	۲		1		
PREAMB	LE: Introduction ab	oout solar thermal energy conversion systems, ene	ergy colle	ctors, s	olar th	ermal
energy s	torage devices, a	pplications of solar thermal energy and cost	estimati	on for	solar	plant
impleme	ntation.					
PREREQU	JISITE COURSES: Ba	asic Electrical & Electronics Engineering.				
COURSE						
The object	ctives of the course	e are to make the students,				
• II	ntroduction about	solar thermal energy conversion systems				
• F	xplain about types	of energy collectors and its performance				
• L	Inderstand in detai	il about solar thermal energy storage systems				
• ()utline about Pract	ical applications of solar thermal energy				
• F	xplain about the co	ost estimation and installation related issues of solu	ar therm	al energ	v	
c	onversion				, 7	
COURSE	OUTCOMES:					
Upor	the successful cor	npletion of the course, students will be able to:				
CO Nos.		Course Outcomes	Knowle on re	edge Lev evised E Faxonor	vel (Ba Bloom' my)	sed s
CO1	Discuss about ty	pes of solar thermal energy conversion systems		К2		
CO2	Explain about wo	orking of energy collectors and its performance		К2		
CO3	Understand in de	etail about solar thermal energy storage systems		К2		
CO4	Understand the	practical applications of solar thermal energy		К2		
C05	Explain about th	e cost estimation and installation related issues		К2		

CORRELATION OF COS AND POS

of solar thermal energy conversion

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											L	L
CO2		Н	Н					М	М			
CO3		Н										
CO4			Н		Н	L	Н				L	L
CO5		L			L			М	М		L	L

COURSE CONTE	NT:	
UNIT I	INTRODUCTION	9
Devices for the radiation, Instru- geometry, Empi surface.	rmal collection and storage, Thermal applications, Extra-terrestrial and uments for measuring solar radiation and sunshine, Solar radiation data rical equations for predicting the availability of solar radiation and solar r	d terrestrial solar a, Solar radiation adiation on tilted
UNIT II	ENERGY COLLECTORS	9
Basic concept or reflectors, Cylir Overall loss coe factor, Compou	of liquid flat plate collectors, Concentrating collectors, Flat-plate collendrical parabolic collector, Performance analysis, Transmissivity of the fficient and heat transfer correlations, Collector efficiency factor, Collector deparabolic collector, Parabolic dish collector, Central receiver collector.	ectors with plane le cover system, ctor heat removal
UNIT III	ENERGY STORAGE	9
Introduction to concept and pri Other solar pon	thermal energy storage, sensible and latent heat storage, Thermo chemi nciple of working of solar pond, Description, Performance analysis, Opera d concepts.	cal storage, Basic ational problems,
UNIT IV	APPLICATIONS	9
Introduction to heaters, Solar agriculture appl	solar air heater, Performance analysis of conventional air heater, of thermal energy for cooling, refrigeration and air conditioning, therr ications, domestic and industrial applications.	ther types of air mal desalination,
UNIT V	COST ESTIMATION	9
Simple payback sensitivity analy and scope, tech	period, return on investment, net present value, internal rate of return rsis, Financing options, energy performance contracts and role of ESCOs, nical design and Financing, Project planning techniques; CPM and PERT.	n, cash flows and Project definition
	TO	TAL: 45 PERIODS
TEXT BOOKS:		
1. Means	R.S, 'Green Building: Project Planning and Cost Estimating', Kingston, 200	6.
2. Kibert .	C.J. 'Sustainable Construction: Green Building Design', 2 nd Edition, Wiley, 2	2007.
REFERENCE BO	OKS:	
1. Boecke	r .J, 'Integrative Design Guide to Green Building', Wiley, 2009.	
2. Eicker .	J, 'Low Energy Cooling for Sustainable Buildings', Wiley, 2009.	

COURSE CODE:	COURSE TITLE:	L	Т	Р	С		
10213EE146	RENEWABLE ENERGY WITH GRID		0	0	3		
COURSE CATEGORY: MINOR							

PREAMBLE: This course aims to give complete knowledge about distributed generation of renewable energy sources and integration issues of hybrid renewable energy sources with grid.

PREREQUISITE COURSES: Basic Electrical & Electronics Engineering

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- Understand about distributed and grid connected energy generation
- Working concept of multiple renewable energy generation systems
- Grid integration issues of renewable energy generation

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understanding about distributed and grid connected energy generation	К2
CO2	Explain about the working of turbine generators for different renewable energy sources	К2
CO3	Discuss about distributed generation and equipment's required	К2
CO4	Renewable energy with grid integration and its issues	К2
CO5	Hybridization of multiple renewable energy resources with grid	К2

CORRELATION OF COS AND POS

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											L	L
CO2		Н	Н					М	М			
CO3		Н										
CO4			Н		Н	L	Н				L	L
CO5		L			L			М	М		L	L

COURSE CONTER	NT:	
UNIT I	INTRODUCTION	9
Distributed Gen systems, Load cu curve data accu long range plan money, decision	eration System: Decentralized versus Central Station generation, urves and Load curve analysis. Coincidence behaviour and Load curv rately Planning and Planning Process: Planning finding the best alten ning. Cost and Economic Evaluation of Distributed Generation: Co s bases and cost effectiveness evaluation.	Traditional, power ves measuring load ernative, Short and osts, time value of
UNIT II	ENERGY GENERATION	9
Basic gas turbin generators Sola powered genera	e generator concepts: Utility system turbine generators; Mini and r thermal power generations, Utility Scale PhotoVoltaic (USPV) tion; Biomass based generation.	micro gas turbine generation; Wind
UNIT III	DISTRIBUTED GENERATION	9
DG Evaluation: C of demand, AC a inverter, control	Cost from past, present, and future, basic DG cost analysis, cost evalu and DC power generation – energy and storage requirement calcula ler requirements.	ation and schedule ations – converter,
UNIT IV	GRID INTEGRATION	9
Grid Interconnec of DG-interconn the grid by RE policy Economi assessment, cost	ction Issues and Need of Integration of Renewable Energy: The pow ections, type of DG grid interconnection, DG-Grid interconnections systems integration; Interfacing techniques; Innovations required ics: Grid-connected energy storage schemes; response requ t considerations.	er grid, Pro & cons issues - Effects on in technology and irement, capacity
UNIT V	HYBRID SOURCE INTEGRATION	9
Hybrid Energy So applications; cor storage schemes	ystems: types, integration issues of hybrid energy generation with a mparison of schemes; System design concept: Techno-economic pestimation.	grid, Principles and rformance; Energy
	т	OTAL: 45 PERIODS
TEXT BOOKS:		
 Willis H Willis H 	Lee, 'Distributed Power Generation: Planning and Evaluation', Marcel Lee, 'Power Distribution Planning Reference Book', Marcel Dekker, In	l Dekker, Inc. c.
REFERENCE BOC	DKS:	
1. Ali Keyh Electric F	ani, Mohammad N Marwali, Min Dai, 'Integration of Green and Re Power Systems', Wiley.	newable Energy in
2. Kaushik Delhi, Ca	N D, Kaushik Kshitij, 'Energy Ecology and Environment: A Technologic apital Publishing Company.	al Approach', New

B.Tech. Programme in Electrical and Electronics Engineering with Honors in Smart Grid Technologies

SI.No.	Course Code	Lecture Courses	L	т	Ρ	с
1	10212EE161	Smart Grid	3	0	0	3
2	10212EE164	Energy Management and SCADA	3	0	0	3
3	10212EE165	Power System Restructuring	3	0	0	3
4	10212EE166	Distributed Generation and Micro Grid	3	0	0	3
5	10212EE168	IoT Applications in Smart Grid	3	0	0	3
6	10212EE169	AI for Smart Grid Systems	3	0	0	3

COURSECODE:	COURSE TITLE:	L	Т	Р	С
10212EE171	SMART GRID	3	0	0	3

COURSE CATEGORY: Honors

PREAMBLE: To enable the students acquire knowledge on smart grid, different options of architectural design and sensors, measurement technology for various aspects of smart grid, renewable energy sources and storage integration with smart grid.

PREREQUISITE COURSES: Power System Analysis.

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- To understand the basic concepts, components and architecture of smart grid.
- To understand the various communication technologies in smart grid.
- To understand the various measurement smart energy meters in smart grid.
- To understand the power quality measurement in smart grid.
- To brief about role of Renewable Energy Storage and Electric Vehicles in smart grid.

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.				С	ourse O	outcome	S				Knowledge Level (Based on revised Bloom's Taxonomy)					
CO1	Explie trans	cate the mission	e need grid	of sma	s of	К2										
CO2	Desc	escribe the concept of communication technologies of smart grid										К2				
CO3	Exem	Exemplify the smart meters, sensors and their role in smart grid										K2				
CO4	Analy	Analyse the power quality measurement in smart grid										К2				
CO5	Analy grid	/se the	renewa	ible ene	ergy sto	rage an	d electr	ic vehic	le for s	mart		К2	<u>.</u>			
CORRE		I OF CO	s WITH	POs AN	D PSOs											
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	Н		М		М			М					М	н		
CO2	Н	М						М					М	н		
CO3	Н			М	М			М					М	н		
CO4	Н	М	М		М			М					М	Н		
CO5	Н			М				М					М	Н		

COURSE CO	NTENT:	
UNIT I	INTRODUCTION	9
Today's Gi Enhanceme policies in S Transmissic	rd Versus Smart Grid, Rationale for Smart Grid, Computational Intelligence, Power nt, Communication and Standards, Environment and Economics, Present development & Inte Smart Grid, Architecture of smart grid, Functions of smart grid components, characteristics on Grid.	System rnational of Smart
UNIT II	COMMUNICATION TECHNOLOGIES TO SMART GRID	9
Introduction Smart Grid communica Communica	n to Smart grid communication network, IEEE P2030 communication model, Services suppo I communication network, Communications Technologies available for Smart Grids, tions, Power line communication, Comparison of communication Technologies, Sm itions Requirements- Security-System reliability. Smart grid communication standards.	orted in a , Mobile art Grid
UNIT III	SMART METERS AND SENSORS	9
Introduction smart grid, (IED) & thei Grid.	n to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI nee Phasor Measurement Unit (PMU), Functional requirements of PMUs, Intelligent Electronic r application for monitoring & protection, Wide Area measurement system (WAMS), Sensors	ds in the c Devices for Smart
UNIT IV	POWER QUALITY MEASUREMENT IN SMART GRID	9
Power Qua Quality Cor techniques	ity & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Source iditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit, Opt and applications to smart grid.	es, Power imization
UNIT V	RENEWABLE ENERGY STORAGE AND ELECTRIC VEHICLE	9
Benefits of technologie	renewable generation, Importance of micro grid, Demand response issues, Energy s, Grid integration issues of renewable energy sources. Vehicle Architecture, PHEV technology	storage
	TOTAL: 45	PERIODS
TEXTBOOK	۶: 	
1. Jan 2. Jan	es Momoh, 'Smart Grid: Fundamentals of design and analysis', John Wiley & Sons Inc, IEEE Pre aka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihi kookoyam 'Sma baologyand Applications' John Wiley Sons Inc. 2012	ess 2012. art Grid:
Tec	mologyand Applications , John Wiley John inc, 2012.	
Tec REFERENCE	BOOKS:	
Tec REFERENCE 1. Fer Pre	BOOKS: Pidoon P.Sioshansi, 'Smart Grid: Integrating Renewable, Distributed & Efficient Energy', A Ss, 2012	Academic
REFERENCE 1. Fer Pre 2. Stur	BOOKS: eidoon P.Sioshansi, 'Smart Grid: Integrating Renewable, Distributed & Efficient Energy', A ss, 2012 art Borlase, 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press, 2016	Academic
REFERENCE 1. Fer Pre 2. Stu 3. Lars & S	BOOKS: eidoon P.Sioshansi, 'Smart Grid: Integrating Renewable, Distributed & Efficient Energy', / ss, 2012 art Borlase, 'Smart Grid: Infrastructure, Technology and Solutions', CRC Press, 2016 5 T. Berger and Krzysztof Iniewski, 'Smart Grid Applications, Communications, and Security', Jo ons, 2012.	Academic ohn Wiley

COL	JRSECO	DE:				COUR	SE TITLE	:			L	Т	Р	C		
10	212EE1	72		EI	NERGY	MANAG	EMENT	AND SC	ADA		3	0	0	3		
COURS	E CATE	GORY: H	lonors								·	·				
PREAM Manag System	1BLE: T ement. is and a	his cou Studen pplicatio	irse pro ts may on of SC	ovides a gain kn ADA wit	n upda owledge h the as	ite, to e on En ssociated	the kno ergy Au deconor	owledge Iditing, mic bene	base Lighting efits.	of the s system	student s and N	s, in e Aainten	ssential ance of	Energy Energy		
PRERE	QUISITE	COURS	ES: Pow	ver Syste	em Analy	ysis										
COURS The	E EDUC object Unc Unc Enh Exp Fam	ATIONA ives of t derstanc derstanc ance th ose to t niliarize	AL OBJEC the cour the fur the ecc e knowl he conce the app	CTIVES: se are to ndament onomic a edge in ept of su lication	o make t als of er analysis lighting uperviso of SCAD	the stud nergy m and syst and cog ry contr A in pov	ents, anagem tem ene reneratio rol and c wer syste	ient fund irgy man on. lata acqu ems	ctions nagemer uisition.	nt for ele	ectrical s	system a	and equi	oment.		
COURS Upon t	E OUTC	COMES: essful co	ompletio	on of the	e course	, studer	nts will b	e able to	0:							
CO Nos.				C	Course C	Outcome	25				Knowl revise	edge Le d Bloom	vel (Bas 1's Taxor	ed on iomy)		
CO1	Unde audit	erstand t process	the conc	ept of E	nergy N	lanagen	nent fun	ctions, a	and ene	ſgy		к	2			
CO2	Unde syste	erstand t ms	he princ	ciple of e	econom	ic analys	sis and s	ystem e	nergy			К	2			
CO3	Unde	erstand t	he Ener:	gy Cons	ervatior	n option:	s in Ligh	ting and	its cont	rol		К	2			
CO4	Unde	erstand t	he impo	ortance	of SCAD	A and fu	inctiona	l require	ements			к	2			
CO5	Unde	erstand t	he SCAI	DA appli	cations	and wid	e area p	rotectio	ons			К	2			
CORRE	LATION	OF COs	5 WITH F	POs AND	PSOs						-					
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1			М						Н		М		М	L		
CO2	Н								н		М		М	L		
CO3	Н		М						М		Μ		М	L		
CO4	Н								Н		Μ		М	Μ		
CO5									н		М		М	М		

COURSE CO	DNTENT:								
UNIT I	ENERGY MANAGEMENT FUNCTION	9							
Need for e and Report their Functi	nergy management – energy management program,Energy accounting – Energy monitoring, ing, Energy audit process, Energy Management centers and their Functions, Architectures of ce ons, Energy performance assessment of HVAC system.	Targeting enters and							
UNIT II	ECONOMIC ANALYSIS AND SYSTEM ENERGY MANAGEMENT	9							
Important o Control, Sys on power q	Important concepts in an economic analysis, Electricity tariff, Electrical Load Management and Maximum Demand Control, Systems and equipment, Electric motors, Transformers, Capacitors -power factor and effect of harmonics on power quality, Energy efficiency analysis on electrical power system, motor and transformer.								
UNIT III	LIGHTING AND COGENERATION	9							
Concept of Optimizing Energy perf	lighting systems – the task and the working space, Light sources – ballasts –luminaries, lighting lighting energy, lighting and energy standards, Forms of cogeneration – Feasibility of coge formance analysis of lighting and cogeneration.	g controls, eneration,							
UNIT IV	SUPERVISORY CONTROL AND DATA AQUISITION	9							
SCADA - Fu SCADA arch	nctional requirements and Components, General features, Functions and Applications, Benefit nitectures, SCADA Communication: various industrial communication technologies	s, Various							
UNIT V	SCADA APPLICATIONS	9							
SCADA App improveme protection.	lications: Utility Applications, Transmission and distribution sector-Operations, Monitoring, An Int, Substation automation structure, Substation automation architecture, Introduction to v	alysis and wide area							
	TOTAL: 45	PERIODS							
TEXTBOOK	S:								
 Stuar Publi Gord Newr 	rt A. Boyer 'SCADA - Supervisory Control and Data Acquisition', Instrument Society of cations, USA, The Instrumentation system and Automation Society, 4 th Edition, 2010 on Clarke, Deon Reynders 'Practical Modern SCADA Protocols: DNP3, 60870.5 and Related nes An Imprint of Elsevier Publications, 1 st Edition, 2004	America Systems',							
REFERENCE	BOOKS:								
1. Wayı	ne C. Turner, Steve Doty 'Energy Management Hand Book', The Fairmont Press, 6 th Edition, 200	7							

2. Amit K. Tyagi, 'Handbook on Energy Audits and Management', Tata Energy Research Institute, 2nd Reprint, 2003

CO	URSECC	DE:				COU	IRSE TIT	LE:				L	Т	Р	С
10	212EE1	EE173 POWER SYSTEM RESTRUCTURING 3 0 0 3 ATEGORY: Honors													
COUR	COURSE CATEGORY: Honors														
PREAN and sta	//BLE: To ability a	o provic nalysis v	le depth with its	n knowl solutior	edge ab n technio	out the ques.	concep	ots of po	wer sys	tem loa	d flow a	analys	is, fa	ult ar	nalysis
PRERE	QUISIT		SES: Pov	wer Syst	em Ana	llysis									
COURS The COURS	SE EDUC objectiv • To • To • To • To • To • To	CATION res of th o under o under o unders o unders o unders o unders	AL OBJE e course stand t ring. rstand n mana stand th stand th stand at	CTIVES e are to he ope the iss gement e basic le essen bout the	make tl ration c sues re architec ce of ele technic	he stude of restr lated t cture, tr ectric er cal chall	ents, uctured o Rest ansfer c nergy tra enges ir	power ructurin capabilit ading, v n restruc	system g and y issues olatility cturing	and k about and tra , risk and	ey issue transm nsmissi d pricing	es in hissior on sei	elect ma vices	ric u anage s.	tilities ment,
Upon t	the succ	cessful c	ompleti	ion of th	ne cours	e, stude	ents will	l be able	to:						
CO Nos.				(Course (Dutcom	es				Know or	vledge revis Taxe	e Lev ed B onon	el (Ba loom ny)	ased 's
CO1	Eluci	date the	e concej	pt of De	regulati	on, diff	erent er	ntities					К2		
CO2	Expla	ain the c	oncept	of mark	ket struc	ctures a	nd biddi	ing					К2		
CO3	Expla	ain the t	ransmis	sion pri	cing issu	ues and	Ancillar	ry servic	es				К2		
CO4	Expla	ain the A	Ancillary	service	s mana	gement							K2		
CO5	Addr	ess the	technic	al challe	enges in	Restruc	cturing						К2		
CORRE		N OF CO	s WITH	POs AN	D PSOs										
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO1	2 P	SO1	PSO2
CO1	Μ								М		Μ			М	М
CO2	М		Μ								М			М	Μ
CO3	Μ								Μ					М	Μ
CO4	M		М						Μ		M		+	M	M
CO5	M										M			IVI	M

COURSE CO	NTENT:							
UNIT I	DEREGULATION OF ELECTRIC SUPPLY INDUSTRY	9						
Introduction	n about deregulation – Structure of restructured electric utility – Different entities – De	regulation						
situation ar	ound the world (Qualitative treatment) – Benefits from competitive electricity market	et – After						
effects of de	eregulation. Role of Load Managers.							
UNIT II	POWER SYSTEM OPERATION IN COMPETITIVE ENVIRONMENT	9						
Role of ISO – Comparison of two different market structures – Operational planning activities of ISO – ISO in bilateral markets – Operational planning activities of GENCO – GENCO in pool and bilateral markets – Market participation issues – Competitive bidding.								
UNIT III	TRANSMISSION OPEN ACCESS AND PRICING ISSUES	9						
Power whee power trans	eling – Types of transmission services in open access – Cost components in transmission – sactions – Pricing mechanisms in various countries.	Pricing of						
UNIT IV	ANCILLARY SERVICES MANAGEMENT	9						
General des power as ar	scription of some ancillary services – Ancillary service management in various countries - n ancillary service – Synchronous generators as ancillary service providers	- Reactive						
UNIT V	TECHNICAL CHALLENGES AND AVAILABILITY BASED TARIFF	9						
Total transf compute A Congestion	er capability – Limitations - Margins – Available transfer capability (ATC) – Procedure - M TC – Static and Dynamic ATC –Concept of Congestion Management – Bid, Zonal a Principles - Generation Rescheduling,beneficiaries and applications	ethods to and Node						
	TOTAL: 45	PERIODS						
TEXTBOOKS	5:							
1. Kanka Kluwe 2. Loi Le	ar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, 'Operation of Restructured Power er Academic Publishers, 2001. ei Lai, 'Power system Restructuring and Deregulation', John Wiley Sons, 2001.	Systems',						
REFERENCE	BOOKS:							
1. Shahi 2. M.Illio	dehpour.M and Alomoush.M, 'Restructuring Electrical Power Systems', Marcel Decker Inc. c, F.Galiana and L.Fink, 'Power Systems Restructuring: Engineering and Economics	, 2001. ć, Kluwer						

Academic Publishers, 2000.

COURSECODE	:
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COURSE TITLE:

DISTRIBUTED GENERATION AND MICRO GRID

L T P C 3 0 0 3

10212EE174

COURSE CATEGORY: Honors

PREAMBLE: Distributed Generation system would provide the platform for the use of renewable sources which are the key to a sustainable energy supply infrastructure. The course aims at giving an adequate exposure in distributed generation systems, economics of distributed resources, and Photovoltaic Systems, State of the art of hybrid systems and major issues of connecting DG into the system.

PREREQUISITE COURSES: Renewable Energy Sources, Power System Analysis

COURSE EDUCATIONAL OBJECTIVES:

The objectives of the course are to make the students,

- The concept of distributed generation with their effect on distribution system
- The impact of grid integration and its technical aspects
- The concept of Micro grid and its configuration
- The operating modes and control concepts of micro grid

COURSE OUTCOMES:

Upon the successful completion of the course, students will be able to:

CO Nos.				C	ourse O	utcome	S				Knowledge Level (Based or revised Bloom's Taxonomy					
CO1	Reco _g with	gnize th their eff	e need o ect on d	of sittin _{ listributi	g and siz	zing of c em.	listribut	ed gene	ration a	long	К2					
CO2	Analy	vze the r	equirem	nents foi		К2										
CO3	Explain the stability and power quality issues on the system due to DG										К2					
CO4	Explicate the configuration and structure of AC and DC micro grids										К2					
CO5	Descr	ribe the	operatio	onal and	l control	concep	ts of mi	cro grid				К2				
CORRE	LATION	OF COs	WITH F	POs AND) PSOs											
COs	PO1	PO2	PO3	PO4	PO5	PO6	P07	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
CO1	Н						М						Н	М		
CO2	Н	М		М		М	М						Н	М		
CO3	Μ												Н	М		
CO4	Н	М		М			М						Н	М		
CO5	Н						м						н	М		

COURS	E CONTENT:	
UNIT	NEED FOR DISTRIBUTED GENERATION	9
Renewa Siting a	ble sources in distributed generation – Current scenario in distributed generation – Planning nd sizing of DGs – Optimal placement of DG sources in distribution systems.	of DGs –
UNIT	I GRID INTEGRATION OF DGS	9
Concep for inte issues in	t of distributed generations, topologies, selection of sources, regulatory standards/ framework, S rconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, DG implementations. Basics of Energy storage elements: Batteries, ultra-capacitors, flywheels.	Standards , security
UNIT I	II TECHNICAL IMPACTS OF DGS	9
Require grid ab power s	ments for grid interconnection, limits on operational parameters, voltage, frequency, THD, res normal operating conditions, islanding issues. Impact of grid integration with NCE sources or ystem: reliability, stability and power quality issues.	sponse to n existing
UNIT I	V BASICS OF MICROGRID	9
Concep	t and definition of microgrid, microgrid drivers and benefits, review of sources of microgrid	s, typical
structur microgr	e and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC ids.	C and AC
UNIT	/ CONTROL AND OPERATION OF MICROGRID	9
Modes control, commu	of operation and control of microgrid: grid connected and islanded mode, Active and reactive protection issues, anti-islanding schemes: passive, active and communication-based techniques, mication infrastructure, Power quality issues in micro grids.	ve power microgrid
	TOTAL: 45	PERIODS
TEXTBO	OKS:	
1.	H. Lee Willis, Walter G. Scott, 'Distributed Power Generation – Planning and Evaluation', Marce Press, 2000.	el Decker
2.	Robert Lasseter, Paolo Piagi, 'Micro-grid: A Conceptual Solution', PESC 2004, June 2004.	
REFERE	NCE BOOKS:	
1.	F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Re International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-2	esources', 23, 2005.
2.	Bollen M.H. and Hassan F. (2011); Integration of Distributed Generation in the Power System, W Press	Viley-IEEE
3.	Nikos Hatziargyriou, "Microgrids: Architectures and Control", ISBN: 978-1-118- 72068-4, Decemb Wiley-IEEE Press.	ber 2013,
4.	M.GodoySimoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Generators', CRC press.	Induction
5.	Keyhani A. (2011); 'Design of Smart Power Grid Renewable Energy Systems', Wiley–IEEE Press	

COU	COURSECODE: COURSE TITLE: L T F									Р	С				
102	12EE	175			IoT A	PPLICAT		I SMART	GRID			3	0	0	3
COURSE	E CAT	EGORY: I	Honors												
PREAM	BLE: ⁻	To enable	e the st	udents a	acquire	knowled	dge on I	loT, diffe	erent op	otions o	f commu	inicatio	on teo	chnol	ogies
and mea	asure	ment tec	hnology	for vari	ous asp	ects of s	mart gr	id.							
PREREC	UISIT	E COURS	SES: Pow	ver Syste	m Analy	ysis									
COURSE	E EDU	CATION	AL OBJE	CTIVES:											
The	objec	tives of t	he cours	e are to	make t	he stude	ents,								
•	In Int	e emergi ternet of	ing area Things a	of Interi Ind Sma	net of 11 rt Grid A	nıngs an Applicati	id Smart ions.	Gria.							
COURSE		COMES:	0												
Upon th	ne suc	cessful c	ompletio	on of the	e course	, studer	nts will b	e able to	o:						
CO Nos.		Course Outcomes Knowledge Level (Based on revised Bloom's Taxonomy)													
C01	Des	escribe the concepts of Internet of Things and Smart Grid K2													
CO2	Expl	Explain the IoT technologies and communication technologies K2													
CO3	Expl	icate the	applica	tions of	HAN, N	AN and '	WAN					K	2		
CO4	Spel	ll out the	suitable	archite	ctures f	or loT ai	ided Sm	art grid s	systems			K	2		
CO5	Enu prot	merate t cotypes o	he suita f IoT aid	ible arcł ed smar	nitectur t grid sy	e, possi vstems	ble app	lications	and ex	kisting		K	2		
CORREL	.ATIO	N OF CO	s WITH F	POs AND	PSOs										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS	D1	PSO2
CO1	Н		М				М						F	ł	Μ
CO2	Н						М						F	ł	Μ
CO3	Н		н										F	ł	Μ
CO4	Н			Н		Н	М						N	1	Μ
CO5	Н						М						N	1	Μ
COURSE CONTENT:															
UNIT	1	IOT AND	SMART	GRID											9
Internet Smart G	t of Tł Grid.	nings - Sn	nart Gric	l- Impor	tance of	f Smart (Grid in S	Smart Cit	ies-Inte	gration	of the In	ternet	of Th	ings i	nto a
UNIT	INIT II IOT ANDCOMMUNICATION TECHNOLOGIES 9										9				
loT Tec (NAN)- V	hnolo Wide	gies – C Area Net	Commun twork (W	ication [·] /AN), Ac	Technol tivities i	ogies: H in IoT, S	Home A mart Gr	rea Net id and Io	work (H Taided	IAN) - I Smart g	Neighbou grid syste	ırhood ms.	Area	ı Net	work

UNIT III	APPLICATIONS OF IOTAIDED SMART GRID SYSTEMS	9
HAN applications power trans	tions: Smart Home – Electric vehicle – AMI – Integration of DERs – Power demand managem : Smart Distribution – smart patrol – WAN applications: Transmission tower protection – mon mission lines.	ent- NAN itoring of
UNIT IV	ARCHITECTURES FOR IOT AIDED SMART GRID SYSTEMS	9
Smart Grid / – Web enab	Architecture Model – Three layered architecture – Four layered architecture – Cloud based arc led smart grid architecture – Last meter smart grid architecture.	hitecture
UNIT V	PROTOTYPES FOR IOT AIDED SMART GRID SYSTEMS	9
A Simple Pr	ototype for Energy Efficiency- Integration of Renewable and Non-Renewable energy Sources	at Home-
In Home Ap	pliance Monitoring Implementation- Real time Monitoring of Medium Voltage Grid – Open	issues &
challenges.		
	TOTAL: 45	PERIODS
TEXTBOOKS	:	
1. P. Wa	her, 'Learning Internet of Things' Packt Publishing, 2015.	
2. N. Ra	mesh Babu, 'Smart Grid Systems: Modeling and Control', CRC Press, 2018.	
REFERENCE	BOOKS:	
1. D. Ke	Imereit, 'The Silent Intelligence: The Internet of Things' DnD Ventures, 2013.	
2. F.P.S	ioshansi, 'Smart Grid: Integrating Renewable, Distributed and Efficient Energy', Academic Pres	s, 2011.
3. A. Mo	Ewen and H. Cassimally, 'Designing the Internet of Things' John Wiley & Sons, 2013.	

S. Borlase, 'Smart Grids: Advanced Technologies and Solutions', 2nd Edition. CRC Press, 2017.

COURSECODE: COURSE TITLE: L Т Ρ С 10212EE176 **AI FOR SMART GRID SYSTEMS** 3 0 0 3 **COURSE CATEGORY:** Honors **PREAMBLE:** To enable the students acquire knowledge on artificial intelligent, different options of programming language related to emerging technology for various aspects of smart grid. **PREREQUISITE COURSES:** Power System Engineering **COURSE EDUCATIONAL OBJECTIVES:** The objectives of the course are to make the students, • To understand the principles and approaches of artificial intelligence (AI) To convey the ideas in AI research and programming language related to emerging technology. • To expose the real-world applications of AI ٠ **COURSE OUTCOMES:** Upon the successful completion of the course, students will be able to: со Knowledge Level (Based on **Course Outcomes** revised Bloom's Taxonomy) Nos. CO1 Explore the fundamental concepts in Artificial Intelligence К2 Explain the AI technologies and solving problems in real world К2 CO2 К2 CO3 Describe the applications of pattern recognition and its application CO4 К2 Explain the artificial neural networks and different learning Enumerate the possible applications and existing prototypes of AI aided CO5 К2 smart grid systems **CORRELATION OF COS WITH POS AND PSOS** COs PO1 PO2 PO3 **PO4** PO5 **PO6 PO7 PO8 PO9** PO10 PO11 PO12 PSO1 PSO2 CO1 Н Μ Μ CO2 Н Μ CO3 Н Μ CO4 Н Μ Μ Μ

Μ

CO5

Н

COURSE CO	NTENT:	
UNIT I	INTRODUCTION TO AI	9
Definition, A searching te knowledge reasoning, n	Applications, Components of an AI program, production system, Problem Characteristics, ov echniques. Knowledge representation: Knowledge representation issues, and overview. Rep using rules; procedural versus declarative knowledge. Logic programming, forward versus natching control knowledge.	erview of presenting backward
UNIT II	AI TECHNOLOGIES	9
Problem Re Techniques-	epresentation and Schemes- Problem Solving in AI- Blind Search Techniques- Heurist Game Searches- Computer Vision- Natural Language Processing- Speech Recognition.	ic Search
UNIT III	PATTERN RECOGNITION	9
Introductior concept of algorithms;	n, automatic pattern recognition scheme. Design Concepts, Methodologies, Concepts of feature selection. Feature selection based on means and covariances. Statistical classifi incrementcorrection and LMSE. Algorithms, Applications.	Classifier, er design
UNIT IV	ARTIFICIAL NEURAL NETWORKS	9
Biological N neural nets,	euron, Neural Net, use of neural 'nets, applications, Perception, idea of single layer and i backpropagation, Hopfield nets, supervised and unsupervised learning, reinforcement learni	multilayer ing.
UNIT V	APPLICATIONS OF ARTIFICIAL INTELLIGENCE	9
Case-Based Tourism, Inc	Reasoning- Applications of CBR Systems- Constraint Programming- AI Applications: E-Com dustry, case study of smart grid	merce, E-
	TOTAL: 45	PERIODS
TEXTBOOKS	:	
 Kevin Institu Rajen 	Warwick, Arthur Ekwue and Raj Aggarwal, 'Artificial Intelligence Techniques in Power Syst ution of Electrical Engineers, 1997. dra Akerkar, 'Introduction to Artificial Intelligence' 2 nd Edition, Prentice-Hall India Pvt. Ltd., 201	ems' <i>,</i> The 14.
REFERENCE	BOOKS:	
1. Mar	iuszFlasiński, 'Introduction to Artificial Intelligence', Springer,2016	
2. Wo	Ifgang Ertel, 'Introduction to Artificial Intelligence', Springer, 2017.	
3. Eug	ene Charniak, 'Introduction to Artificial Intelligence', Pearson Education, 2016	
4. N.P	. Padny, 'Artificial Intelligence and Intelligent Systems', Oxford University Press, 2005.	
5. Serg	gios meodonais, konstantinos koutroumdas Pattern Recognition", Elsevier, 2003.	