Sri Sivasubramaniya Nadar College of Engineering

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Regulation 2021

Curriculum and Syllabi for
B.E. Electrical and Electronics Engineering

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

- To inculcate the right mix of knowledge, attitudes and character in students to enable them take up positions of responsibility in the society and make significant contributions.
- To produce talented Electrical and Electronics Engineers through quality education, to be a Centre of Excellence and become a source of cutting-edge technologies in the field of Electrical and Electronics Engineering.
- To become a preferred partner in the area of collaborative research among national and international organizations.

MISSION

- To achieve global eminence in the field of Electrical and Electronics Engineering.
- To be a highly preferred destination comparable with the best in the world for students aspiring to enter the field of Electrical and Electronics Engineering.
- To nurture the talent and to facilitate the students with all round personality development to make a positive difference to society through education.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the programme will have successful career by their ability to contribute in the electrical and electronics engineering or related professional fields

PEO2: Graduates of the programme can work in teams with technical competencies, discharging their professional and social responsibilities.

PEO3: Graduates of the programme will exhibit demonstrable attributes in lifelong learning to contribute to their chosen professional field.

PROGRAMME OUTCOMES (POs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree programme, the students should 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.

PO4.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.

PO5.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.

PO6. 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.

PO7. 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.

PO9. 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 self, and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

After the successful completion of the B.E. Electrical and Electronics Engineering degree programme, Graduate will have the ability to:

PSO1: To apply advanced science and engineering knowledge to analyse and design complex electrical and electronic devices, software and systems containing hardware and software components.

PSO2: To design and analyze systems used in advanced power applications, renewable energy, electrical drives for the transportation, manufacturing industries and in allied technical fields.

PEOs Mapping with POs and PSOs

PEO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	P08	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
PEO1	3	3	3	3	3	2	2	2	2	2	2	2	3	3
PEO2	1	1	1	1	1	3	3	3	3	3	2	2	1	1
PEO3	1	1	1	1	1	1	2	2	2	2	3	3	1	2

MAPPING OF COURSES WITH POs AND PSOs

Course	POs												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
Semester I														
Technical English									2	3		2		
Matrices and Calculus	3	2											1	
Engineering Physics	3	2	1											
Engineering Chemistry	3	2	1											
Problem Solving and Programming in Python	2	2	2	1										
Engineering Graphics	3	2	2			2				3				
Programming in Python Lab	3	3		1				1	3	2				
Physics and Chemistry Lab	3													
Semester II														
Complex Functions and Laplace Transforms	3	2										1		
Basic Electrical and Electronics Engineering	3	3	2	3									2	2
Electrical circuits and systems - Fundamentals and practices (TCP - EFP)	3	3	2	2	2		3		3	3	3	1	3	
Environmental Science (Non-credit)	3	2	1											
Engineering Mechanics for Electrical Engineers	3	2	2											
Design Thinking and Engineering Practices Lab	3	3	3	3		1			3	1		1	3	
Semester III														
Transform Techniques and Partial Differential Equation	3	2											1	
UHV: Understanding Harmony						2		3	3	2		3		
Signals and Systems	3	3	2	3	3	2	1		2		2	3	3	2
Electromagnetic Theory	3	2	1						1	1		1	3	
Object Oriented Programming and Data Structures for Electrical Engineering	3		2	1	3								3	
Electronic Devices and Circuits	3	2	3	2	2							1	1	3
Electronics Lab	2	2	1	3				1	3	1		1	2	3
Object Oriented Programming and Data Structures Laboratory for Electrical Engineering	3		2	2	3								3	
Semester IV														
Probability and Statistics for Electrical Engineering	3	2		1									1	
Indian Constitution						2		2	2	2	2	1		
Electrical Machines -I	3	2	1	2						1		1	1	3
Analog Electronic Circuits	3	1	3	1	2							1	1	3
Control Systems Engineering	3	3	3	2	2								3	2

Generation, Transmission and Distribution	3	3	2	1	3			1					1	
Electrical Machines -I Lab	2	2	1	3				1	3	1			2	3
Analog Electronic Circuits Lab	3	2	3	2	2				2			1	2	1
Semester V														
Power Electronics	3		2	2	2								1	2
Electrical Machines -II	3	2	1	2	1		1		1	1		1	1	3
Electrical Measurements and Instrumentation Systems	3	2	3	2		2						3	3	2
Digital Logic System Design and Practices (TCP – EFP)	3	2	3	3	3	1	1	1	2	1	2	1	2	1
Electrical Machines -II Lab	3	3	1	3	1			1	3	1		1	2	3
Control System and Instrumentation Lab	1	2	2	3	2	2	3					2	3	3
Semester VI														
Microprocessors and Microcontrollers -Fundamentals and Practices (TCP – EFP)	3	3	3	3	3				2	2			3	3
Power System Analysis	3	3	2	2	3			2				2	1	1
Power System Operation and Control	3	3	3	3	2								3	2
Power Electronics and Drives Lab	3	3	3	3	3								3	2
Power System Simulation Lab	3	3	3	3	3								3	2
Semester VII														
Solid State Drives	3	2	3	1	2								1	3
Protection and Switchgear	3	2	1	1	2	2	2	2				2	3	2
High Voltage Engineering	3	3	3	2	3								2	1
Industrial Training /Internship	3	3	2	3	3	3	3	3	3	2	3	3	3	2
Advanced Electrical and Electronics Design Lab	2	2	1	3	2		1	1	3	1		1		
Project Phase I	3	3	2	3	3	3	3	3	3	2	3	3	3	2
Semester VIII														
Project Phase II	3	3	2	3	3	3	3	3	3	2	3	3	3	2
Professional Electives														
Solar Energy Systems	3	3	2	3	2		2		2	1		1	1	2
Fundamentals of Digital Signal Processing	2	2	3	2	1				2			2	3	3
Energy Resources and Utilization	3	3	1	1				2				2	1	1
Communication Engineering	1	1			2				1			1	2	1
Low Voltage Direct Current Systems	3		2	2	2								1	2
Wind Energy Conversion systems	3	2	2	3	3				2	1		2	2	2
Advanced Control Theory	3	3	2	2	2								3	2
Power System Dynamics	3	3	3	3	3								1	
VLSI Design Techniques	3	3	2	2	2	1						2	2	1
Switched Mode Power Supplies	3	2	2	2	2					1		2	1	2

Energy Storage Systems		3	2	2	2					2			1	2
System Identification and Adaptive Control	3	1	2	2	2	2				1	1	3		
Artificial Intelligence for Power Systems	3	3	2	3	3							1	1	
Automotive Electronics	3	2	2	1		2	2						2	2
Electrical Machine Design	3	3	3	1	3	3	2		1	1	1	1	3	3
Smart Grid	3	2	2	1	1							1	1	2
Principles of Robotics	3	3	3	3	2								3	3
Internet of Things in Power System Engineering	3		2	1	2	1	2	2			2	2	1	
Power Semiconductor Devices	3	3	2	2								1		2
Flexible AC Transmission Systems and Custom Power Devices	3	3	3	3	2									
Distributed Generation and Micro Grid	3	3	3	2	2	1	1		1	1		1	1	2
PLC and SCADA	3		3		2	1	2	2			2	2	1	3
Power System Transients	3	3	3	2	3									
Embedded Systems	3	3	2	3	2	1						2	2	2
High Voltage Direct Current Transmission	3	2	2	2	2							2	2	1
Electric Vehicle and Power Management	3	2	3	2	2	1	1		1		1		1	2
Digital Control Systems	3	3	3	3	3									
Energy Management and Auditing	3	2	2	2	1	2	2		2	2		1		
Microcontroller Based System Design	2		3	3	3							2	2	1
Power Quality	3	3	3	3	2		2	1		1		1	2	1
Management Electives														
Principles of Management					3				2	2	2	1		
Total Quality Management					2	3	2	2	1		1	1		
Work Ethics, Corporate Social Responsibility and Governance						3	2	3	1	1	3	2		
Humanities I electives														
Language and Communication									2	3		2		
Fundamentals of Linguistics									2	3		2		
Film Appreciation									2	3		2		
Human Relations at Work						2		2	3	2		2		
Application of Psychology in Everyday Life						2		2	3	2		2		
Understanding Society and Culture Through Literature									2	3		2		

SUSTAINABLE DEVELOPMENT GOALS (SDG)

SDG		Description
SDG1	No Poverty	End poverty in all its forms everywhere
SDG 2	Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
SDG 3	Good health and well being	Ensure healthy lives and promote well-being for all at all ages
SDG 4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 5	Gender Equality	Achieve gender equality and empower all women and girls
SDG 6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable and modern energy for all
SDG 8	Decent work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9	Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
SDG 10	Reducing Inequality	Reduce income inequality within and among countries
SDG 11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable
SDG 12	Responsible consumption and production	Ensure sustainable consumption and production patterns
SDG 13	Climate action	Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy
SDG 14	Life below water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
SDG 15	Life on Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Peace, justice and string Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
SDG 17	Partnerships for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development

MAPPING OF SUBJECT RELEVANT TO SDG

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Technical English				✓													
Matrices and Calculus				✓													
Engineering Physics				✓													
Engineering Chemistry				✓													
Problem Solving and Programming in Python				✓													
Engineering Graphics				✓													
Programming in Python Lab				✓													
Physics and Chemistry Lab				✓													
Complex Functions and Laplace Transforms				✓													
Basic Electrical and Electronics Engineering				✓													
Electrical Circuits and Systems - Fundamentals and practices (TCP - EFP)				✓													
Environmental Science (Non-credit)			✓	✓		✓	✓						✓	✓	✓		
Engineering Mechanics for Electrical Engineers				✓													
Design Thinking and Engineering Practices Lab				✓													
Transform Techniques and Partial Differential Equation				✓													
UHV: Understanding Harmony			✓	✓													
Signals and Systems				✓													
Electromagnetic Theory				✓													
Object Oriented Programming and Data Structures for Electrical Engineering				✓													
Electronic Devices and Circuits				✓													
Electronics Lab				✓													
Object Oriented Programming and Data Structures Laboratory				✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
for Electrical Engineering																	
Probability and Statistics for Electrical Engineering				✓													
Indian Constitution				✓													
Electrical Machines -I				✓													
Analog Electronic Circuits				✓													
Control Systems Engineering				✓													
Generation, Transmission and Distribution				✓					✓								
Electrical Machines -I Lab				✓													
Analog Electronic Circuits Lab				✓													
Power Electronics				✓													
Electrical Machines -II				✓													
Electrical Measurements and Instrumentation Systems				✓													
Digital Logic System Design and Practices (TCP – EFP)				✓													
Electrical Machines -II Lab				✓													
Control System and Instrumentation Lab				✓													
Microprocessors and Microcontrollers - Fundamentals and Practices (TCP – EFP)				✓													
Power System Analysis				✓													
Power System Operation and Control				✓													
Power Electronics and Drives Lab				✓													
Power System Simulation Lab				✓													
Solid State Drives				✓													
Protection and Switchgear				✓													
High Voltage				✓													

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Engineering																	
Industrial Training /Internship*				✓				✓	✓								
Advanced Electrical and Electronics Design Lab				✓				✓	✓								
Project Phase I				✓				✓	✓								
Project Phase II				✓				✓	✓								
Solar Energy Systems				✓			✓				✓	✓					
Fundamentals of Digital Signal Processing				✓													
Energy Resources and Utilization				✓			✓				✓	✓					
Communication Engineering				✓													
Low Voltage Direct Current Systems				✓													
Wind Energy Conversion Systems				✓			✓				✓	✓					
Advanced Control Theory				✓													
Power System Dynamics				✓													
VLSI Design Techniques				✓													
Switched Mode Power Supplies				✓													
Energy Storage Systems				✓			✓				✓	✓					
System Identification and Adaptive Control				✓													
Artificial Intelligence for Power Systems				✓													
Automotive Electronics				✓													
Electrical Machine Design				✓													
Smart Grid				✓													
Principles of Robotics				✓													
Internet of Things in Power System Engineering				✓													
Power Semiconductor Devices				✓													
Flexible AC Transmission Systems and Custom Power Devices				✓							✓	✓					

	Sustainable Development Goals																
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Distributed Generation and Micro grid				✓							✓	✓					
PLC and SCADA				✓													
Power System Transients				✓													
Embedded Systems				✓													
High Voltage Direct Current Transmission				✓													
Electric Vehicle and Power Management				✓			✓				✓	✓					
Digital Control Systems				✓													
Energy Management and Auditing				✓			✓				✓	✓					
Microcontroller Based System Design				✓													
Power Quality				✓			✓				✓	✓					
Principles Of Management			✓	✓	✓												
Total Quality Management			✓	✓	✓				✓								
Work Ethics, Corporate Social Responsibility and Governance	✓	✓	✓	✓	✓			✓		✓							
Language and Communication				✓				✓									
Fundamentals Of Linguistics				✓				✓									
Film Appreciation																	
Human Relations at Work				✓	✓			✓			✓						
Application Of Psychology in Everyday Life				✓							✓						
Understanding Society and Culture Through Literature				✓							✓						

I to VIII semesters Curriculum - R 2021 (Choice Based Credit System)

SEMESTER I								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEN2176	Technical English	HS	4	2	0	2	3
2	UMA2176	Matrices and Calculus	BS	4	3	1	0	4
3	UPH2176	Engineering Physics	BS	3	3	0	0	3
4	UCY2176	Engineering Chemistry	BS	3	3	0	0	3
5	UGE2176	Problem Solving and Programming in Python	ES	3	3	0	0	3
6	UGE2177	Engineering Graphics	ES	5	1	0	4	3
PRACTICALS								
7	UGE2197	Programming in Python Lab	ES	3	0	0	3	1.5
8	UGS2197	Physics and Chemistry Lab	BS	3	0	0	3	1.5
			TOTAL	**28**	**15**	**1**	**12**	**22**

SEMESTER II									
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**EL**	**C**
	THEORY								
1	UMA2276	Complex Functions and Laplace Transforms	BS	4	3	1	0	0	4
2	UEE2276	Basic Electrical and Electronics Engineering	ES	3	3	0	0	0	3
3	UEE2201	Electrical Circuits and Systems -Fundamentals and practices	ES	6	3	0	3	3	5.5
4	UCY2276	Environmental Science	MC*	3	3	0	0	0	0
5		Humanities I-Elective	HS	4	2	0	2	0	3
6	UMA2276	Engineering Mechanics for Electrical Engineers	ES	3	3	0	0	0	3
	PRACTICALS								
7	UGE2297	Design Thinking and Engineering Practices Lab	ES	3	0	0	3	0	1.5
				TOTAL	**26**	**17**	**1**	**8**	**3**	**20**

*****Non-credit

SEMESTER III								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UMA2376	Transform Techniques and Partial Differential Equation	BS	4	3	1	0	4
2	UHS2376	Universal Human Values 2: Understanding Harmony	HS	4	2	0	2	3
3	UEC2376	Signals and Systems	PC	3	3	0	0	3
4	UEE2301	Electromagnetic Theory	PC	3	2	1	0	3
5	UEE2302	Object Oriented Programming and Data Structures for Electrical Engineering	ES	3	3	0	0	3
6	UEE2303	Electronic Devices and Circuits	PC	3	3	0	0	3
PRACTICALS								
7	UEE2311	Electronics Lab	PC	3	0	0	3	1.5
8	UEE2312	Object Oriented Programming and Data Structures Laboratory for Electrical Engineering	ES	3	0	0	3	1.5
			TOTAL	**26**	**16**	**2**	**8**	**22**

SEMESTER IV								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UMA2452	Probability and Statistics for Electrical Engineering	BS	3	2	1	0	3
2	AHS2476	Indian Constitution	MC	4	3	0	0	0
3	UEE2401	Electrical Machines -I	PC	3	3	0	0	3
4	UEE2402	Analog Electronic Circuits	PC	3	3	0	0	3
5	UEE2476	Control Systems Engineering	PC	3	3	0	0	3
6	UEE2403	Generation, Transmission and Distribution	PC	4	4	0	0	4
PRACTICALS								
7	UEE2411	Electrical Machines -I Lab	PC	3	0	0	3	1.5
8	UEE2412	Analog Electronic Circuits Lab	PC	3	0	0	3	1.5
			TOTAL	**26**	**18**	**1**	**6**	**19**

SEMESTER V									
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**EL**	**C**
	THEORY								
1	UEE2501	Power Electronics	PC	3	3	0	0		3
2	UEE2502	Electrical Machines -II	PC	3	3	0	0		3
3	UEE2503	Electrical Measurements and Instrumentation Systems	PC	3	3	0	0		3
4	UEE2504	Digital Logic System Design and Practices	PC	4	3	0	1	3	4.5
5		Management –Elective	HS	3	3	0	0		3
6		Professional Elective- I	PE	3	3	0	0		3
	PRACTICALS								
7	UEE2511	Electrical Machines -II Lab	PC	3	0	0	3		1.5
8	UEE2512	Control System and Instrumentation Lab	PC	4	0	0	4		2
			TOTAL	**26**	**18**	**0**	**8**		**23**

SEMESTER VI									
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**EL**	**C**
	THEORY								
1	UEE2601	Microprocessors and Microcontrollers - Fundamentals and Practices	PC	4	3	0	1	3	4.5
2	UEE2602	Power System Analysis	PC	3	3	0	0		3
3	UEE2603	Power System Operation and Control	PC	3	3	0	0		3
4		Professional Elective- II	PE	3	3	0	0		3
5		Professional Elective -III	PE	3	3	0	0		3
6		Open Elective I	OE	3	3	0	0		3
	PRACTICALS								
7	UEE2611	Power Electronics and Drives Lab	PC	4	0	0	4		2
8	UEE2612	Power System Simulation Lab	PC	3	0	0	3		1.5
			TOTAL	**26**	**18**	**0**	**8**		**23**

SEMESTER VII								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATE GORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1	UEE2701	Solid State Drives	PC	3	3	0	0	3
2	UEE2702	Protection and Switchgear	PC	3	3	0	0	3
3	UEE2703	High Voltage Engineering	PC	3	3	0	0	3
4		Professional Elective- IV	PE	3	3	0	0	3
5		Professional Elective -V	PE	3	3	0	0	3
PRACTICALS								
6	UEE2716	Industrial Training /Internship*	EEC	0	0	0	0	2
7	UEE2711	Advanced Electrical and Electronics Design Lab	PC	4	0	0	4	2
8	UEE2718	Project Phase I	EEC	6	0	0	6	3
			TOTAL	**25**	**15**	**0**	**10**	**22**

* The students will undergo 4 weeks Industrial training / Internship/ In-house Research Projects during previous vacation

SEMESTER VIII								
Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**C**
THEORY								
1		Professional Elective -VI	PE	3	3	0	0	3
2		Open Elective – II	OE	3	3	0	0	3
PRACTICALS								
3	UEE2818	Project Phase II	EEC	16	0	0	16	8
			TOTAL	**22**	**6**	**0**	**16**	**14**

CATEGORY WISE LISTING OF SUBJECTS

BASIC SCIENCE COURSES (BS)

S.No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Matrices and Calculus	I	4	3	1	0	0	4
2	Engineering Physics	I	3	3	0	0	0	3
3	Engineering Chemistry	I	3	3	0	0	0	3
4	Physics and Chemistry Lab	I	3	0	0	3	0	1.5
5	Complex Functions and Laplace Transforms	II	4	3	1	0	0	4
6	Transform Techniques and Partial Differential Equation	III	4	3	1	0	0	4
7	Probability and Statistics for Electrical Engineering	IV	3	2	1	0	0	3
Total Credits								22.5

ENGINEERING SCIENCE COURSES (ES)

S.No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Problem Solving and Programming in Python	I	3	3	0	0	0	3
2	Engineering Graphics	I	5	1	0	4	0	3
3	Programming in Python Lab	I	3	0	0	3	0	1.5
4	Basic Electrical and Electronics Engineering	II	3	3	0	0	0	3
5	Electrical Circuits and Systems - Fundamentals and practices (TCP – Type a)	II	6	3	0	3	3	5.5
6	Design Thinking and Engineering Practices Lab	II	3	0	0	3	0	1.5
7	Engineering Mechanics for Electrical Engineers	II	3	3	0	0	0	3
8	Object Oriented Programming and Data Structures for Electrical Engineering	III	3	3	0	0	0	3
9	Object Oriented Programming and Data Structures Laboratory for Electrical Engineering	III	3	0	0	3	0	1.5
Total Credits								**25**

HUMANITIES AND SOCIAL SCIENCE COURSES (HS)

Sl. No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Technical English	I	4	2	0	2	0	3
2	Humanities I-Elective	II	4	2	0	2	0	3
3	Humanities II -UHV: Understanding Harmony	III	4	2	0	2	0	3
4	Management –Elective	V	3	3	0	0	0	3
							Total Credits	**12**

PROFESSIONAL CORE COURSES (PC)

SL. No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Signals and Systems	III	3	3	0	0	0	3
2	Electromagnetic Theory	III	3	2	1	0	0	3
3	Electronic Devices and Circuits	III	3	3	0	0	0	3
4	Electronics Lab	III	3	0	0	3	0	1.5
5	Electrical Machines -I	IV	3	3	0	0	0	3
6	Analog Electronic Circuits	IV	3	3	0	0	0	3
7	Control Systems Engineering	IV	3	3	0	0	0	3
8	Generation, Transmission and Distribution	IV	4	4	0	0	0	4
9	Electrical Machines -I Lab	IV	3	0	0	3	0	1.5
10	Analog Electronic Circuits Lab	IV	3	0	0	3	0	1.5
11	Power Electronics	V	3	3	0	0	0	3
12	Electrical Machines -II	V	3	3	0	0	0	3
13	Electrical Measurements and Instrumentation Systems	V	3	3	0	0		3
14	Digital Logic System Design and Practices (TCP – EFP)	V	4	3	0	1	3	4.5
15	Electrical Machines -II Lab	V	3	0	0	3	0	1.5
16	Control System and Instrumentation Lab	V	4	0	0	4	0	2
17	Microprocessors and Microcontrollers - Fundamentals and Practices (TCP -EFP)	VI	4	3	0	1	3	4.5
18	Power System Analysis	VI	3	3	0	0	0	3
19	Power System Operation and Control	VI	3	3	0	0	0	3
20	Power Electronics and Drives Lab	VI	4	0	0	4	0	2
21	Power System Simulation Lab	VI	3	0	0	3	0	1.5
22	Solid State Drives	VII	3	3	0	0	0	3
23	Protection and Switchgear	VII	3	3	0	0	0	3
24	High Voltage Engineering	VII	3	3	0	0	0	3
25	Advanced Electrical and Electronics Design Lab	VII	4	0	0	4	0	2
							Total Credits	**68.5**

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Industrial Training /Internship	VII	0	0	0	0	0	2
2	Project Phase I	VII	6	0	0	6	0	3
3	Project Phase II	VIII	16	0	0	16	0	8
							Total Credits	13

MANDATORY COURSES (MC)

Sl. No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Environmental Science	II	3	3	0	0	0	0
2	Indian Constitution	IV	4	2	0	2	0	0
							Total Credits	**0**

PROFESSIONAL ELECTIVES (PE)

Sl. No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Professional Elective- I	V	3	3	0	0	0	3
2	Professional Elective- II	VI	3	3	0	0	0	3
3	Professional Elective -III	VI	3	3	0	0	0	3
4	Professional Elective- IV	VII	3	3	0	0	0	3
5	Professional Elective -V	VII	3	3	0	0	0	3
6	Professional Elective -VI	VIII	3	3	0	0	0	3
							Total Credits	**18**

OPEN ELECTIVE (OE)

S.No	COURSE TITLE	SEMESTER	CONTACT PERIODS	L	T	P	EL	C
1	Open Elective I	VI	3	3	0	0	0	3
2	Open Elective – II	VIII	3	3	0	0	0	3
							Total Credits	**6**

SUMMARY OF CATEGORY WISE CREDITS

SEMESTER	HS	BS	ES	PC	PE	OE	EEC	Total Credits (Sem Wise)
I	3	11.5	7.5					22
II	3	4	13					20
III	3	4	4.5	10.5				22
IV		3		16				19
V	3			17	3			23
VI				14	6	3		23
VII				11	6		5	22
VIII					3	3	8	14
Total Credits	**12**	**22.5**	**25**	**68.5**	**18**	**6**	**13**	**165**

PROFESSIONAL ELECTIVES

Sl. No.	Course Code	Course Title	Specialization/ Domain	Contact Periods	L	T	P	C
Professional Elective – I- Semester V								
1	UEE2521	Solar Energy Systems	Renewable Energy Systems	3	3	0	0	3
2	UEE2522	Fundamentals of Digital Signal Processing	Control and Automation	3	3	0	0	3
3	UEE2523	Energy Resources and Utilization	Power Engineering	3	3	0	0	3
4	UEE2524	Communication Engineering	Electronic systems	3	3	0	0	3
5	UEE2525	Low Voltage Direct Current Systems	Power Electronics and Drives	3	3	0	0	3
Professional Elective - II - Semester VI								
6	UEE2621	Wind Energy Conversion Systems	Renewable Energy Systems	3	3	0	0	3
7	UEE2622	Advanced Control Theory	Control and Automation	3	3	0	0	3
8	UEE2623	Power System Dynamics	Power Engineering	3	3	0	0	3
9	UEE2624	VLSI Design Techniques	Electronic Systems	3	3	0	0	3
10	UEE2625	Switched Mode Power Supplies	Power Electronics and Drives	3	3	0	0	3
Professional Elective - III - Semester VI								
11	UEE2626	Energy Storage Systems	Renewable Energy Systems	3	3	0	0	3
12	UEE2627	System Identification and Adaptive Control	Control and Automation	3	3	0	0	3
13	UEE2628	Artificial Intelligence for Power Systems	Power Engineering	3	3	0	0	3
14	UEE2629	Automotive Electronics	Electronic systems	3	3	0	0	3
15	UEE2631	Electrical Machine Design	Power Electronics and Drives	3	3	0	0	3

Professional Elective - IV - Semester VII								
16	UEE2721	Smart Grid	Renewable Energy Systems	3	3	0	0	3
17	UEE2722	Principles of Robotics	Control and Automation	3	3	0	0	3
18	UEE2723	Internet of Things in Power System Engineering	Power Engineering	3	3	0	0	3
19	UEE2724	Power Semiconductor Devices	Electronic systems	3	3	0	0	3
20	UEE2725	Flexible AC Transmission Systems and Custom Power Devices	Power Electronics and Drives	3	3	0	0	3
Professional Elective - V - Semester VII								
21	UEE2726	Distributed Generation and Micro grid	Renewable Energy Systems	3	3	0	0	3
22	UEE2727	PLC and SCADA	Control and Automation	3	3	0	0	3
23	UEE2728	Power System Transients	Power Engineering	3	3	0	0	3
24	UEE2729	Embedded Systems	Electronic systems	3	3	0	0	3
25	UEE2731	High Voltage Direct Current Transmission	Power Electronics and Drives	3	3	0	0	3
Professional Elective - VI - Semester VIII								
26	UEE2821	Electric Vehicles and Power Management	Renewable Energy Systems	3	3	0	0	3
27	UEE2822	Digital Control Systems	Control and Automation	3	3	0	0	3
28	UEE2823	Energy Management and Auditing	Power Engineering	3	3	0	0	3
29	UEE2824	Microcontroller Based System Design	Electronic systems	3	3	0	0	3
30	UEE2825	Power Quality	Power Electronics and Drives	3	3	0	0	3

HUMANITIES I - ELECTIVES (II SEMESTER)

SL. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	UEN2241	Language and Communication	4	2	0	2	3
2	UEN2242	Fundamentals of Linguistics	4	2	0	2	3
3	UHS2243	Film Appreciation	4	2	0	2	3
4	UHS2241	Human Relations at Work	4	2	0	2	3
5	UHS2242	Application of Psychology in Everyday Life	4	2	0	2	3
6	UEN2243	Understanding Society and Culture Through Literature	4	2	0	2	3

MANAGEMENT ELECTIVE (V SEMESTER)

SL. No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	UBA2541	Principles of Management	3	3	0	0	3
2	UBA2542	Total Quality Management	3	3	0	0	3
3	UBA2543	Work Ethics, Corporate Social Responsibility and Governance	3	3	0	0	3

HONOURS DEGREE (Minimum 6 courses)

Specialization title: Artificial Intelligence and Machine Learning for Electrical Systems

Sl. No	Course Code	Course Title	Contact Periods	L	T	P	EL	C
1	UEE2H21	Principles of Artificial Intelligence	3	3	0	0	0	3
2	UEE2H22	Fundamentals of Machine Learning	3	3	0	0	0	3
3	UEE2H23	Fundamentals of Information Theory	3	3	0	0	0	3
4	UEE2H24	Big Data Analytics	3	3	0	0	0	3
5	UEE2H25	Application of Machine Learning and Deep Learning to Power System Problems	3	3	0	0	0	3
6	UEE2H26	Artificial Intelligence Application in Power Systems	3	3	0	0	0	3
7	UEE2H27	Introduction To Autonomous Mobile Robots	3	3	0	0	0	3
8	UEE2H28	Fundamentals of Deep Learning	3	3	0	0	0	3
9	UEE2H29	Foundations of Human Computer Interaction	3	3	0	0	0	3
10	UEE2H30	Fundamentals of Image Processing and Analysis	3	3	0	0	0	3

DETAILED SYLLABI

Semester I

Course Code	Course Title	L	T	P	C
UEN2176	TECHNICAL ENGLISH	2	0	2	3

Objectives:

- To enhance competence in reading comprehension for Science and Technology.
- To improve the writing proficiency specific to proposals, reports, and letters.
- To develop speaking skills for technical presentations, GDs and public speaking.
- To strengthen the listening skills of the students to enable them to listen and comprehend lectures and talks.
- To strengthen the grammatical competency.

Unit I	BASICS OF COMMUNICATION	9

Language development: Subject verb Agreement, Tenses(simple), Conjunctions, Numerical adjective

Vocabulary development: Root words–Prefixes & Suffixes, Standard abbreviations,

Reading: Comprehension of short technical texts-skimming and scanning,

Writing: Describing an object, the process of an event/experiment and others, Paragraph Writing

Listening: Listening for taking notes and seeking clarifications (classroom lectures/ ted talks etc)

Speaking: Self-introduction and introducing others/short conversations in formal and informal contexts

Unit II	MAKING PRESENTATIONS	9

Language development: The pronouns-antecedent agreement, Tenses-continuous, If conditionals, Adverbs

Vocabulary development: Collocations and fixed expressions, Avoidance of Jargons

Reading: Comprehension of longer texts – (Interpretative and Critical levels of meaning),

Writing: Writing definitions (single sentence and extended), Expository and Persuasive Essays,

Listening: Listening Comprehension Tasks,

Speaking: Making technical presentations

Unit III	LISTENING TO SPEAK	9

Language development: Prepositions, Tenses-perfect, Articles, Embedded sentences,

Vocabulary development: Compound words, Formal and informal vocabulary,

Reading: Reading reviews, advertisements, SOPs for higher studies

Writing: Writing instruction and recommendations, formal and informal letters/ emails, Writing SOPs

Listening: Listening to longer technical talks and discussion

Speaking: Demonstrating working mechanisms

Unit IV	READING FOR SPEAKING	9

Language development: Reported speech, Active and Passive voices, Framing ‘Wh’ and ‘Yes’ or ‘No’ questions,

Vocabulary development: Technical vocabulary, Verbal analogies, Reading: Reading industrial case studies, interpreting technical text and making notes Writing: Interpreting charts and graphs, writing blogs and vlogs Listening: Listening to telephonic conversations and online interviews Speaking: Participating in group discussions		
Unit V	**PROFESSIONAL NEEDS**	9
Language development: Phrasal verbs, clauses, compound and complex sentences Vocabulary development: Single-word substitutes, Vocabulary retention strategies, Reading: Reading for IELTS, GER, TOEFL Writing: Writing proposals and reports, writing minutes of the meeting, Listening: Listening Skills for Proficiency Tests like IELTS Speaking: Job Interviews (face to face and online) – basics		
	Total Periods	45

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

CO 1: To read and comprehend texts (technical) effectively.

CO 2: To write proposals, reports, emails, letters, SOPs meeting professional expectations.

CO 3: To Improve Vocabulary (use of right collocations, idioms and phrases etc).

CO 4: To enhance their grammatical competency for writing and speaking.

CO 5: To improve their ability to listen and comprehend at deeper levels

Text Books:

1. Praveen Sam, D., and Shoba N, A., Course in Technical English, Cambridge University Press, New Delhi, 2020.

References:

1. Sudharshana, N.P., and Saveetha, C., English for Technical Communication, CambridgeUniversity Press, New Delhi, 2016.
2. Raman, Meenakshi, Sharma, and Sangeetha, Technical Communication Principles andPractice, Oxford University Press, New Delhi, 2014.
3. Kumar, Suresh, E., Engineering English, Orient Blackswan, Hyderabad, 2015.
4. Booth L. Diana, Project Work, Oxford University Press, 2014.
5. Grussendorf, Marion, English for Presentations, Oxford University Press, 2007.
6. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges, Cengage Learning, USA, 2007

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	-	-	-	-	-	-	-	2	3	-	2			
2	-	-	-	-	-	-	-	-	2	3	-	2			
3	-	-	-	-	-	-	-	-	2	3	-	2			
4	-	-	-	-	-	-	-	-	2	3	-	2			
5	-	-	-	-	-	-	-	-	2	3	-	2			

Course Code	Course Title	L	T	P	C
UMA2176	MATRICES AND CALCULUS	3	1	0	4

Objectives:

- To reduce quadratic form to canonical form of a matrix and identify its nature
- To analyse the convergence of infinite series
- To study the concept of evolute and envelope
- To find the extreme values for a function of two variables
- To compute area of closed surface and volume of solids using multiple integrals

Unit I	MATRICES	12

Characteristic equation - Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors, Cayley-Hamilton Theorem – statement and applications, Diagonalization of matrices – Similarity transformation - Quadratic form - Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms. .

Unit II	SEQUENCES AND SERIES	12

Sequences - Definition and examples, Series - Types of Convergence, Series of positive terms, Tests of convergence - Comparison test, Integral test and D'Alembert's ratio test, Alternating series – Leibnitz's test, Series of positive and negative terms, Absolute and conditional convergence.

Unit III	APPLICATIONS OF DIFFERENTIAL CALCULUS	12

Curvature, radius of curvature - Cartesianand parametric co-ordinates – Centre of curvature – Circle of curvature in Cartesian form, Evolutes, Envelopes (including two parameter family), Evolute as envelope of normal.

Unit IV	FUNCTIONS OF SEVERAL VARIABLES	12

Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and its properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

Unit V	MULTIPLE INTEGRALS	12

Double integrals in Cartesian and polar coordinates – Change of order of integration, Area enclosed by plane curves – Change of variables in double integrals, Triple integrals.

Total Periods	60

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

CO1: Reduce quadratic form to canonical form by orthogonal transformation and identify the nature of the quadratic form

CO2: Analyse the convergence of a given infinite series

CO3: Find evolute of a given curve and envelope of family of curves

CO4: Find the extrema of function of two variables

CO5: Evaluate the double and triple integrals

CO6: Application of extreme points of functions and multiple integrals in engineering Problems

Text Books:

1.	Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.
2.	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2016.

References:

1.	Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Ninth Edition, Laxmi Publications Pvt Ltd., 2016.
2.	James Stewart, Calculus: Early Transcendental, Cengage Learning, New Delhi, 7th Edition, 2013.
3.	Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
4.	Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												
2	3	2												
3	3	2												
4	3	2												
5	3	2												
6	3	2										1		

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UPH2176	**ENGINEERING PHYSICS**	**3**	**0**	**0**	**3**

Objectives:

- Comprehend and identify different crystal structures and their imperfections.
- Explain the elastic and thermal properties of materials and understand their significance.
- Develop an understanding of quantum mechanical phenomena and their applications.
- Provide an overview of the characteristics of sound, architectural acoustics and the production, detection and applications of ultrasound.
- Explain the origin of laser action, production of laser, fibre optics and their applications.

Unit I	**CRYSTAL PHYSICS**	**9**

Single crystalline, polycrystalline and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal Imperfections – Point, line (Edge and Screw dislocations – Burger vectors) Surface (stacking faults) and Volume defects.

Unit II	PROPERTIES OF MATTER AND THERMAL PHYSICS	9
Properties of matter: Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram– Poisson's ratio –Factors affecting elasticity– Torsional stress & deformations – Twisting couple – Torsion pendulum - theory and experiment– bending of beams-bending moment– cantilever: theory and experiment–uniform and non-uniform bending: theory and experiment-I-shaped girders. **Thermal Physics:**Modes of heat transfer – thermal conduction, convection and radiation – Newton's law of cooling - thermal conductivity- Lee's disc method for bad conductor – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel) – Formation of ice on ponds.		
Unit III	**ACOUSTICS AND ULTRASONICS**	9
Acoustics: Classification and characteristics of Sound - decibel - Weber–Fechner law – Sabine's formula - derivation using growth and decay method —factors affecting acoustics of buildings and their remedies - Methods of determination of Absorption Coefficient. Ultrasonics: Production of ultrasonics by Magnetostriction and piezoelectric methods – acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C – scan displays.		
Unit IV	**QUANTUM PHYSICS**	9
Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect. Theory and experimental verification – Properties of Matter waves – wave particle duality - Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states - Scanning electron microscope - Transmission electron microscope.		
Unit V	**PHOTONICS AND FIBRE OPTICS**	9
Photonics: Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients –Conditions for Laser action - Types of lasers – Nd: YAG, & CO2 lasers-Basics of diode lasers-Industrial and Medical Applications. Fibre optics: Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) –Losses in fibers - attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors. - pressure and displacement.		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Analyze crystal structures and the influence of imperfections on their properties.		
CO2: Demonstrate and explain the general concepts of elastic and thermal properties of materials.		
CO3: Explain quantum mechanical theories to correlate with experimental results and their applications to material diagnostics.		
CO4: Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines.		

CO5: Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication.
Text Books:
1. Gaur, R.K., and Gupta, S.L., Engineering Physics, Dhanpat Rai Publishers, 2012.
2. Serway, R.A., & Jewett, J.W., Physics for Scientists and Engineers, Cengage Learning, 2010.
References:
1. Halliday, D., Resnick, R. & Walker, J. Principles of Physics, Wiley, 2015.
2. Tipler, P.A. &Mosca, G. Physics for Scientists and Engineers with Modern Physics, WH Freeman, 2007.
3. Avadhanulu, M. N., Kshirsagar, P. G, A text book of Engineering Physics, S. Chand & Co. Ltd., Ninth Revised Edition, 2012.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2		1	1		2			2					
2	3	2		1	1		2			2					
3	3	2		1	1		2			2					
4	3	2		1	1		2			2					
5	3	2		1	1		2			2					

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UCY2176	**ENGINEERING CHEMISTRY**	**3**	**0**	**0**	**3**

Objectives:

- To impart knowledge to the students on the basic concepts of chemistry and properties of materials for various engineering applications

Unit I	**ATOMIC AND MOLECULAR NANO CHEMISTRY**	**9**

Atoms- Atomic orbitals, Molecules- Molecular orbitals. Nanoparticles and its uniqueness. Distinction between molecules, nanoparticles and bulk materials. Classification of nanoparticles. Size dependent Properties-Thermal, Optical, Chemical, Electronic and Mechanical. Synthesis of nanomaterials - bottom-up and top-down approaches-Techniques-Colloidal, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation. Objectives of surface modification of nanoparticles.Synthesis and applications - Carbon Nano Tubes (CNT) - Gold nanoparticle

Unit II	**ELECTROCHEMISTRY**	9

Conductivity of electrolytes - factors influencing conductivity- Conductometric titration and its applications -estimation of strong acid, estimation of mixture of strong and weak acids and estimation of $BaCl_2$. Electrochemical cell-redox reaction-origin of electrode potential, Types of electrodes, Measurement of electrode potential and emf of the electrochemical cell -reference electrode- saturated calomel electrode and Ag/AgCl electrode - Ion selective electrode-glass electrode measurement of pH –Potentiometric titrations- estimation of ferrous ion and estimation of strong acid. Problems based on all the above concepts.

Unit III	CORRODION AND ITS CONTROL	9
Corrosion-Definition-Classification of corrosion-Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – selection of materials - sacrificial anode and impressed current cathodic methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating		
Unit IV	**PHASE EQUILIBRIA**	9
Phase Rule - Definition and explanation of terms involved with suitable examples- Phase – Components – Degrees of Freedom –Applications and limitations of Phase Rule, One component system - H_2O Two component systems – Construction of phase diagram by Thermal Analysis (or) Cooling curves – Condensed Phase Rule - Simple eutectic systems: Pb-Ag system – System with congruent melting point: Zn-Mg – System with incongruent melting point: Ni-Cd		
Unit V	**SYNTHESIS AND APPLICATIONS OF INDUSTRIAL POLYMERS**	9
Polymers and Polymerization: definition, classification - types of polymerization: addition and condensation –mechanism of addition polymerization (cationic, anionic, free radical and coordination polymerization)-Properties: Glass Transition temperature, Average Molecular weight and its determination by viscosity method. Polymer composites (fibre reinforced plastics)-preparation, properties and application of engineering plastics Epoxy resin, Polyurethans, Nylon 6:6, Polycarbonate, PS, PVC and PET		
	Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to demonstrate understanding on:

CO1: The unique properties of nano-particles and their applications

CO2: The principles of electrochemistry and its application for quantitative analysis

CO3: The various types of corrosion under normal to severe corrosive environments and their control measures

CO4: Construction of phase diagram and its application to analyse simple eutectic systems

CO5: The synthesis, properties and applications of important industrial polymers

Text Books:

1. Engineering Chemistry' by Jain P.C. and Monika Jain, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015
2. Engineering Chemistry by S.S.Dara, S.Chand&Co.Ltd,New Delhi ,2011

References:

1. T. Pradeep- NANO: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw Hill Education; 2017(1st edition)
2. Gurdeep Raj, Phase Rule, GOEL Publishing House, Meerut, 2011.
3. R. Gopalan, K. Rangarajan, P.S. Subramanian. "Elements of Analytical Chemistry" Sultan Chand & Sons,2003.
4. F.W. Billmayer, Textbook of Polymer Science, 3rd Edison, Wiley. N.Y. 1991.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1											
2	3	2	1											
3	3	2	1											
4	3	2	1											
5	3	2	1											

Course Code	Course Title	L	T	P	C
UGE2176	PROBLEM SOLVING AND PROGRAMMING IN PYTHON	3	0	0	3

Objectives:

- To learn algorithmic problem solving techniques.
- To learn the fundamentals of python programming.
- To compose programs in Python using conditions, iterations and decompose a problem into functions
- To construct programs in Python sequenced data type.
- To develop python programs using advanced constructs like dictionaries and files

Unit I	ALGORITHMIC PROBLEM SOLVING	9

Logical and Algorithmic Thinking: Logical Thinking – Algorithmic Thinking; Problem Solving and Decomposition: Defining the Problem – Devising the Solution – Decomposition; Effective building blocks: Basic Algorithmic Constructs (pseudo code, flow chart, programming language) – Program State.

Unit II	DATA, EXPRESSION, STATEMENT, CONDITIONAL	9

Data and types: int, float, boolean, string, list; variables, expressions, statements, simultaneous assignment, precedence of operators; comments; in-built modules and functions; Conditional: boolean values and operators, conditional (if), alternative (if-else), case analysis (if-elif-else).

Unit III	ITERATION, FUNCTION, STRINGS	9

Iteration: while, for, break, continue, pass; Functions: function definition, function call, flow of execution, parameters and arguments, return values, local and global scope, recursion; Strings: string slices, immutability, string functions and methods, string module.

Unit IV	LISTS, TUPLES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters, nested lists, list comprehension; Tuples: tuple assignment, tuple as return value, tuple operations.

Unit V	DICTIONARIES, FILES	9

Dictionaries: operations and methods, looping and dictionaries, reverse lookup, dictionaries and lists; Files: Text files, reading and writing files, format operator, file names and paths; command line arguments.

Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Solve programming problems and express solutions in pseudo code.
CO2: Develop simple programs using basic constructs.
CO3: Construct programs using conditions and iterations decompose a problem into functions.
CO4: Make use of strings, lists, tuples and dictionaries data structures.
CO5: Perform Input/Output Operations using files.
Text Books:
1. Karl Beecher, ``Computational Thinking – A beginner's Guide to Problem Solving and Programming", British Computer Society (BCS), 2017.
2. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist", 2nd edition, Green Tea Press, Shroff/O'Reilly Publishers, 2015 (http://greenteapress.com/wp/think-python/)
References:
1. John V Guttag, ``Introduction to Computation and Programming Using Python", 3rd edition, MIT Press, 2021.
2. Ashok NamdevKamthane, Amit Ashok Kamthane, ``Programming and Problem Solving with Python", McGraw Hill Education (India) Private Limited, 2018.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, ``Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
4. Timothy A. Budd, ``Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, ``Fundamentals of Python: First Programs", 2nd Edition, CENGAGE Learning, 2018.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	0	0										
2	2	2	0	0										
3	2	3	2	1										
4	2	3	2	1										
5	2	2	2	1										

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UGE2177	**ENGINEERING GRAPHICS**	**1**	**0**	**4**	**3**

Objectives:

- To develop the graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

	Concepts and Conventions (Not for Examinations)	
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning		
Unit I	**PLANE CURVES AND FREEHAND SKETCHING**	**10**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.		
Unit II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	15
Orthographic projection principles - Principal planes - First angle projection - Layout of views - Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
Unit III	**PROJECTION OF SOLIDS**	15
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		
Unit IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	20
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of truncated solids (simple position only) – Prisms, pyramids, cylinders and cones.		
Unit V	**ISOMETRIC AND PERSPECTIVE PROJECTION**	15
Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method.		
	Total Periods	75
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Draw Plane curves and perform Free hand sketching of three - dimensional objects		
CO2: Draw the Orthographic projections of points, lines and plane surfaces.		
CO3: Draw the Projections of solids.		
CO4: Draw the Projections of sectioned solids and Development of surfaces.		
CO5: Draw the Isometric and Perspective projections of solids.		
Text Books:		
1. Natarajan, K.V., A Textbook of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020. [ISBN:9788190414089]		
2. Venugopal, K. and Prabhu Raja, V., Engineering Graphics, New Age International (P) Limited, 15th Edition, 2018. [ISBN :9789386649249]		
References:		

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House, 53rd Edition, 2014. [ISBN: 9789380358963]
2. Basant Agarwal, and Agarwal, C.M., Engineering Drawing, McGraw Hill, 3rd Edition, 2019. [ISBN: 9789353167448]
3. Gopalakrishna, K.R., Engineering Drawing (Vol. I & II Combined), Subhas Publications, 27th Edition, 2017. [ISBN: 9789383214235]
4. Luzzader J Warren, and Jon M Duff, Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Pearson Education, 11th Edition, 2005. [ISBN :9789332549982]

Publication of Bureau of Indian Standards

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	-	-	2	-	-	-	3	-	-			
2	3	2	2	-	-	2	-	-	-	3	-	-			
3	3	2	2	-	-	2	-	-	-	3	-	-			
4	3	2	2	-	-	2		-	-	3	-	-			
5	3	2	2	-	-	2	-	-	-	3	-	-			

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UGE2197	**PROGRAMMING IN PYTHON LAB**	**0**	**0**	**3**	**1.5**

Objectives:

- To write, test, and debug simple Python programs.
- To apply conditions and loops to solve problems using python.
- To implement programs using functions
- To write programs using different data types such as strings, lists tuples and dictionaries
- To perform read and write operations into the files.

List of Experiments:

1. Use Linux shell commands, use Python in interactive mode, and an editor
2. Write simple programs (area of a geometric shape, simple interest, solve quadratic equation, net salary).
3. Write programs using conditional statements (leap year, maximum of 2 numbers,

maximum of 3 numbers, simple calculator, grade of the total mark).

4. Develop programs using loops and nested loops (gcd, prime number, integer division, sum of digits of an integer, multiplication table, sum of a series, print patterns, square root using Newton's method).
5. Develop programs using functions (sine and cosine series, Pythagorean triplets).
6. Develop programs using recursion (efficient power of a number, factorial, Fibonacci number).
7. Develop programs using strings (palindrome, finding substring) without using in-built functions.
8. Develop programs using lists and tuples (linear search, binary search, selection sort, insertion sort, quicksort).
9. Develop programs using nested lists (matrix manipulations).
10. Develop simple programs using dictionaries (frequency histogram, nested dictionary).
11. Develop programs using Files (read and write files).
12. Develop programs to perform any task by reading arguments from command line.
13. Implement a simple application using appropriate datatypes and files

Total Periods: 45

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

CO1: Write, test, and debug simple Python programs

CO2: Build Python programs with conditionals and loops

CO3: Solve a problem using functions in python programming

CO4: Construct python programs using compound data like lists, tuples, and dictionaries

CO5: Build a simple application in teams using files and appropriate datatypes by applying the best programming practices

References:

1.Karl Beecher, ``Computational Thinking – A beginner's Guide to Problem Solving and Programming", British Computer Society (BCS), 2017.

2.Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist", 2nd edition, Green Tea Press, Shroff/O'Reilly Publishers, 2015 (http://greenteapress.com/wp/think-python/)

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	0	0	-	-	-	1	-	-	-	-		
2	3	3	0	1	-	-	-	1	-	-	-	-		
3	3	3	0	1	-	-	-	1	-	-	-	-		
4	3	3	0	1	-	-	-	1	-	-	-	-		
5	3	3	0	2	-	-	-	1	3	2	-	-		

Course Code	Course Title	L	T	P	C
UGS2197	PHYSICS AND CHEMISTRY LABORATORY	0	0	3	1.5

A. PHYSICS LABORATORY

COURSE OBJECTIVE:

The objective of this course is to enable the students to

- Obtain basic Knowledge about physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of the Young's modulus of the material of the given beam by Non-uniform bending method.
2. Determination of the rigidity modulus of the material of the given wire using torsion pendulum.
3. Determination of the wavelength of the mercury spectra using Spectrometer and grating.
4. Determination of the dispersive power of a prism using Spectrometer.
5. Determination of the grating element/wavelength, and particle size/ wavelength using a laser.
6. Determination of the Numerical and the acceptance angle of an optical fiber.
7. Determination of the thickness of a thin wire using interference fringes.
8. Determination of the coefficient of viscosity of the given liquid using Poiseuille's method.
9. Determination of the band gap energy of a semiconductor.
10. Determination of the coefficient of thermal conductivity of the given bad conductor using Lee's disc.

COURSE OUTCOMES

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

CO1: Apply principles of elasticity, optics, viscosity, thermal and band gap determination for engineering applications

CO-PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3			2	1										

B. CHEMISTRY LABORATORY

COURSE OBJECTIVE:

The objective of this course is to enable the student to impart hands on training for all the possible concepts learned in Engineering Chemistry Course

LIST OF EXPERIMENTS

(A minimum of 6 experiments to be performed from the given list)

1. Estimation of ferrous ion by potentiometric titration
2. Estimation of strong acid using pH meter.
3. Estimation of strong acid by conductometric titration
4. Estimation of mixture of strong and weak acids using conductometer
5. Estimation of $BaCl_2$ by conductometric titration
6. Determination of degree of polymerization of a water-soluble polymer by Viscosity method
7. Determination of equivalent conductance of a strong electrolyte at infinite dilution
8. Determination of weak acid using weak base by conductometric titration.
9. Determination of rate of corrosion by weight loss method

TOTAL PERIODS: 45

TEXT BOOK

1. Manual Prepared by Faculty of Chemistry and Physics Department, SSNCE

REFERENCES

1. Practical Physical Chemistry,B. Viswanath and P.S.Raghavan, ViVa Books VT.Ltd,New Delhi, 2012.

COURSE OUTCOMES

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

CO1: Analyse ions like Fe2+, Fe3+, H+ using different instruments

CO2: Determine the Molecular weight and Degree of Polymerisation using viscometer

CO-PO/PSO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												1		2
CO2	3												1		2

Semester II

Course Code	Course Title	L	T	P	C
UMA2276	**COMPLEX FUNCTIONS AND LAPLACE TRANSFORMS**	**3**	**1**	**0**	**4**

Objectives:

- Applying C-R equations in the construction of Analytic Functions.
- Study the methods of Complex Integration, finding Taylor's and Laurent's Series expansions.
- Find the Laplace Transforms and inverse transforms for standard functions.
- Solve Differential Equations using different techniques.
- Evaluate Line, Surface and Volume integrals.

Unit I	**ANALYTIC FUNCTIONS**	**12**

Analytic functions – necessary and sufficient conditions, Cauchy-Riemann equations in Cartesian and polar form (with proof) – Properties - harmonic functions, Construction of analytic function, conformal mapping - some standard transformations $-w = z + c, cz, \frac{1}{z}, z^2$, bilinear transformation.

Unit II	**COMPLEX INTEGRATION**	12

Line integral - Cauchy's integral theorem – Cauchy's integral formula, Taylor's and Laurent's series, Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour (except the poles on the real axis).

Unit III	**LAPLACE TRANSFORMS**	12

Definition, properties, existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function, shifting theorems, Transforms of derivatives and integrals, Initial and final value theorems, Periodic functions, Inverse transforms – Convolution theorem.

Unit IV	**ORDINARY DIFFERENTIAL EQUATIONS**	12

Solution of second and higher order linear differential equation with constant coefficients $(f(x) = e^{mx}, sinmx, cosmx, x^n, f(x)e^{mx}, f(x)sinmx)$, Method of variation of parameters, Simultaneous linear equations with constant coefficients of first order, Solving linear second order ordinary differential equations with constant coefficients using Laplace transforms.

Unit V	**VECTOR CALCULUS**	12

Gradient and directional derivative – Divergence and curl – Vector identities – Irrotational and Solenoidal vector fields, Line integral over a plane curve, Surface integral - Area of a curved surface, Volume integral, Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

Total Periods	60

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

CO1: Solve problems in Analytic functions and construction of analytic functions using C-R equations.
CO2: Solve problems using integration techniques, find Taylor's and Laurent's Series expansions.
CO3: Obtain the Laplace Transforms and inverse transforms of standard functions.
CO4: Solve Differential Equations using different techniques.
CO5: Evaluate Line, Surface and Volume integrals.
CO6: application of Complex integration, Laplace transforms, Ordinary differential equations, and vector calculus in engineering problems
Text Books:
1. Grewal, B.S., Higher Engineering Mathematics, 44th Edition, Khanna Publishers, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, Inc., 2016.
References:
1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, 11th Edition, Global Edition, Wiley, 2017.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2014.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2012.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, Global Edition, John Wiley & Sons, Inc., 2017.
6. Srimanta Pal and Subodh C. Bhunia, Engineering Mathematics, Oxford University Press, 2015.
7. Srivastava, A.C., and Srivastava, P.K., Engineering Mathematics Volume I and II, PHI learning Pvt. Ltd, 2011.

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												
2	3	2												
3	3	2												
4	3	2												
5	3	2												
6	3	2												1

Course Code	Course Title	L	T	P	C
UEE2276	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	3

Objectives:

- To learn the basic concepts of electric circuits.
- To know the operation of various electrical machines.
- To study the concepts of utilization of electrical power.
- To comprehend the working principle of electronic devices and its applications.
- To grasp the working principle of various sensors and transducers.

Unit I	ELECTRICAL CIRCUITS	9

DC Circuits: Ohm's Law- Kirchhoff's laws - Mesh current and Node voltage methods (Analysis with only independent source). Network theorems - Superposition theorem, Thevenins theorem and Norton theorem. AC circuit: Waveforms and RMS value, Phasor diagram, Power, Power factor. Three phase supply – Star connection, Delta connection – Balanced Loads - Power in three-phase systems.

Unit II	ELECTRICAL MACHINES	9

Construction, Principle of Operation, Basic Equations and Applications - DC Generators, DC Motors, Single Phase Transformer, Single phase Induction Motor, Three phase Induction Motor, Three phase Alternator, Stepper and BLDC motors.

Unit III	UTILIZATION OF ELECTRICAL POWER	9

Renewable energy sources- wind and Solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Batteries-NiCd, Pb Acid and Li ion Charge and Discharge Characteristics. Protection- Earthing, Fuses. Energy Tariff calculation for domestic loads.

Unit IV	ELECTRONIC DEVICES AND APPLICATIONS	9

Operation of PN junction diodes, VI characteristics, Zener diode, BJT- CB, CE, CC configurations, input and output characteristics, MOSFET. Half wave and full wave rectifier, capacitive filters, zener voltage regulator, Operational amplifiers, Ideal Op-Amp characteristics, Inverting and Non-inverting amplifier.

Unit V	SENSORS AND TRANSDUCERS	9

Sensors: Capacitive and resistive sensors, magnetic sensors, Hall effect sensors, Piezo-resistive sensors, viscosity, optical sensors, Ultrasonic sensors, Nuclear and microsensors.

Transducers: Classification of transducers, strain gauges, RTD, thermocouples, Piezo-electric, LVDT and Thermo electric transducers

Total Periods	45

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

CO1: Analyze DC and AC circuits.

CO2: Explain the operating principle of AC and DC machines.

CO3: Describe the utilization of electric power.

CO4: Describe the working principle of electronic devices and its applications
CO5: Describe the working principle of sensors and transducers.
Text Books:
1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education,2014
2. Alan S. Moris, Principles of Measurements and Instruments, Prentice Hall of India Pvt. Ltd., New Delhi,1999.
3. S.Salivahanan, R.Rengaraj and G.R.Venkatakrishnan, Basic Electrical, Electronics and Measurement Engineering, McGrawHill, 2017.
References:
1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016.
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015.
4. Edward Hughes, John Hiley, Keith Brown and Ian McKenzie Smith "Electrical And Electronic Technology" Pearson Education Ltd, 10 th Edition, 2008
5. H.Cotton, "Electrical Technology" 7th Edition,CBS; 2005

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	**3**	**3**	**2**	**3**									**3**	
2	**3**												**2**	
3	**3**		**2**											**2**
4	**3**												**2**	
5	**3**		**1**										**2**	

Course Code	**Course Title**	**L**	**T**	**P**	**EL**	**C**
UEE2201	**ELECTRICAL CIRCUITS AND SYSTEMS - FUNDAMENTALS AND PRACTICES**	**3**	**0**	**3**	**3**	**5.5**

Objectives:

- To introduce the elements of electric circuits and perform analysis using governing laws
- To impart knowledge on solving electric circuits using network reduction methods and theorems
- To introduce the phenomenon of resonance in electric circuits and to introduce coupled circuits.
- To impart knowledge on transient response of circuits and two port networks.
- To introduce the concept of Phasor diagrams and perform analysis of three phase circuits

Unit I	BASIC CIRCUIT ANALYSIS	12+6
Theory - Resistive, Inductive and Capacitive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis- A.C. circuits – Phasors - Average and RMS value - Phasor Diagram – Power, Power Factor and Energy. **Practice** - Simulation of electrical circuit using Kirchhoff's voltage and current laws using MATLAB / Simulink **Studio** -Energy auditing of department building and cost analysis in implementing solar power-Design and analysis of series and parallel circuits with residential lamp loads.		
Unit II	**NETWORK REDUCTION & THEOREMS FOR DC & AC CIRCUITS**	**12+6**
Theory - Network reduction: voltage and current division, source transformation – star delta conversion. Thevenin and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem. **Practice** -Verification of Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Superposition theorem by Simulation of electrical circuits using MATLAB / Simulink **Studio** - Maximum Power Point Tracking using solar panel-Impedance matching using audio amplifier.		
Unit III	**RESONANCE AND COUPLED CIRCUITS**	**12+6**
Theory - Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits. **Practice** - Simulation of series resonance circuit-Simulation of parallel resonant circuits using MATLAB / Simulink. **Studio** - Analysis of tuned radio receiver circuit.		
Unit IV	**TRANSIENT RESPONSE ANALYSIS AND TWO PORT NETWORKS**	**12+6**
Theory - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input-Characterization of two port networks in terms of Z,Y and H parameters. **Practice** - Simulation of R-C electric circuit transients using MATLAB / Simulink **Studio** - Determination of h-parameters for Common Emitter amplifier.		
Unit V	**THREE PHASE CIRCUITS**	**12+6**
Theory - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced &un balanced – Phasor diagram of voltages and currents – power measurement in three phase circuits. **Practice** - Simulation of three phase balanced and unbalanced star, delta networks circuits using MATLAB / Simulink. **Studio** - Analysis of three phase lamp load connected to two wattmeters		
	Total Periods	90

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

CO1: Understand the concepts of circuit analysis, network reduction methods and network theorems.	
CO2: Demonstrate the application of series, parallel resonance and coupled circuits.	
CO3: Analyze the transient response of electric circuit and characteristics of two port networks.	
CO4: Analyze three phase circuits and various methods of power measurement.	
CO5: Use modern simulation tools for electric circuit analysis.	
CO6: Design and develop electric circuits for practical applications.	
	Text Books:
1.	William H. Hayt Jr, Jack E. Kemmerly, and Steven M. Durbin, Engineering Circuits Analysis, McGraw Hill publishers, New Delhi, 2013.
2.	Charles K. Alexander, Mathew N.O. Sadiku, Fundamentals of Electric Circuits, Second Edition, McGraw Hill, 2013.
	References:
1.	Allan H. Robbins, Wilhelm C. Miller, Circuit Analysis Theory and Practice, Cengage Learning India, 2013.
2.	Chakrabarti, A, Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
3.	Jegatheesan, R., Analysis of Electric Circuits, McGraw Hill, 2015.
4.	Joseph A. Edminister, Mahmood Nahri, Electric circuits, Schaum's series, McGraw-Hill, New Delhi, 2010.
5.	M E Van Valkenburg, Network Analysis, Prentice-Hall of India Pvt. Ltd, New Delhi, 2015.
6.	Mahadevan, K., Chitra, C., Electric Circuits Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2015.
7.	Richard C. Dorf, and James A. Svoboda, Introduction to Electric Circuits, 7th Edition, John Wiley & Sons, Inc. 2015.
8.	Salivahanan, S., Pravin Kumar, S, Circuit Theory, Vikas Publishing House, 2014.
9.	https://www.falstad.com/circuit/

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	1	1	2							1	3	
2	3	3	2	1	2							1	3	
3	3	3	2	2	2							1	3	
4	3	3	2	2	2							1	3	
5	3	3	2	2	2							1	3	
6	3	3	3	3	3		3		3	3	3	3	3	

Course Code	Course Title	L	T	P	C
UCY2276	ENVIRONMENTAL SCIENCE	3	0	0	0

Objectives:

The students of Engineering undergoing this Course would develop a

- Better understanding of human relationships, perceptions and policies towards the environment
- Focus on design and technology for improving environmental quality

Unit I	ENVIRONMENT, ECOSYSTEMSANDBIODIVERSITY	9

Definition, scope and importance of environment– concept, structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession

Introduction to biodiversity definition and types– values of biodiversity- India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity-endangered and endemic species of India -conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Unit II	NATURAL RESOURCES	9

Uses, over-exploitation of natural resources: Forest, Water, Mineral, Food, Energy and Land. Case studies on over exploitation of natural resources -Role of an individual in conservation of natural resources- Equitable use of resources for sustainable life styles.

Unit III	CURRENTENVIRONMENTALISSUES	9

Environmental issues– causes, effects and control measures of Pollution of (a) Air (Smog, acid rain, climate change and global warming, ozone layer depletion) (b) Water (rain water harvesting, watershed management and waste water treatment) (c) Soil (solid waste management, wasteland reclamation) (d)Electronic waste.

Population explosion, Resettlement and rehabilitation of people and Disaster management

Unit IV	ENGINEERING INTERVENTIONS TO REDUCE ENVIRONMENTAL STRESSES	9

Role of information technology in environment- Remote Sensing- satellites and sensors-Geographical Information Systems (GIS)-Applications. Environment data base management system. Green chemistry-Principles - Green buildings-Advantages of green buildings over conventional buildings-Electric and Hybrid Electric Vehicles (HEV)

Unit V	ENVIRONMENTALREGULATIONS	9

Environmental Ethics for sustainable development- Human rights- Environmental Impact Assessment– Ecomark-role of NGO- Central and state pollution control boards- Air (Prevention and Control of Pollution) act 1981– Water (Prevention and control of Pollution) act 1974– Wildlife protection act 1972 – Forest conservation act 1980- The National Green Tribunal Act 2010

Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: The structure and functions of the ecosystems and diversity among life forms within an ecosystem
CO2: The importance of various natural resources and its sustainable use
CO3: The various environmental issues such as pollution, population explosion etc and suggest remedial measures.
CO4: The role of engineering techniques to minimize environmental stress
CO5: The role of various environmental machineries and to ensure proper environmental regulation
Text Books:
1. Anubha Kaushik and C. P. Kaushik, Environmental Science and Engineering, New Age International Publishers,14thEdition, 2014.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi,2006
References:
1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition,Pearson Education, 2004.
2. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	-	1											
2	3	2	1											
3	3	2	1											
4	3	2	1											
5	3	-	-											

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UME2251	**ENGINEERING MECHANICS FOR ELECTRICAL ENGINEERS**	**3**	**0**	**0**	**3**

Objectives:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering

Unit I	**STATICS OF PARTICLES (only vector approach)**	**9**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particlein space- Equivalent systems of forces – Principle of transmissibility.

Unit II	**EQUILIBRIUM OF RIGID BODIES (only vector approach)**	**9**
Free body diagram – Types of supports –Action and reaction forces – stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon‘s theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions		
Unit III	**PROPERTIES OF SURFACES AND SOLIDS**	**9**
Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments ofinertia.		
Unit IV	**DYNAMICS OF PARTICLES**	**9**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton‘s laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.		
Unit V	**FRICTION AND RIGID BODY DYNAMICS (only vector approach)**	**9**
Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction – ladder friction - Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Illustrate the vectoral and scalar representation of forces and moments (BL: L3)		
CO2: Analyze the rigid body in equilibrium (BL: L3)		
CO3: Evaluate the properties of surfaces and solids (BL: L3)		
CO4: Calculate dynamic forces exerted in rigid body (BL: L3)		
CO5: Determine the friction and the effects by the laws of friction (BL: L3)		
Text Books:		
1. Beer, F.P and Johnston Jr. E.R., Vector Mechanics for Engineers (In SI Units): Statics and Dynamics, 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2004.		
2. Vela Murali, Engineering Mechanics, Oxford University Press, 2010		
References:		
1. Bhavikatti S.S. and Rajashekarappa K.G., Engineering Mechanics, New Age International (P) Limited Publishers, 1998.		
2. Hibbeller, R.C and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Edition, Pearson Education, 2010.		

3.	Irving H. Shames, and Krishna Mohana Rao, G., Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education 2006.
4.	Meriam, J.L., and Kraige, L.G., Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2, Third Edition, John Wiley & Sons,1993.
5.	Rajasekaran, S, and Sankarasubramanian, G., Engineering Mechanics Statics and Dynamics, 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	2											
2	3	2	2											
3	3	2	2											
4	3	2	2											
5	3	2	2											

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UGE2297	**DESIGN THINKING AND ENGINEERING PRACTICES LAB**	**0**	**0**	**3**	**1.5**

Objectives:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering
- To train the students to dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the different engineering components

List of Experiments:

GROUP A (CIVIL & MECHANICAL ENGINEERING PRACTICE)

I - CIVIL ENGINEERING PRACTICE

Buildings:

Study of plumbing and carpentry components of residential and industrial buildings - Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.

(b) Preparation of plumbing line sketches for water supply and sewage works.

(c) Hands-on-exercise:

- Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
- Plumbing with basic connections for washing basin and sink

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise: Wood work, joints by sawing, planning and cutting.
- Fabrication of different models of pencil box and pen stand.
- Fabrication of wooden wall shelf

(c) Demonstration of wood working machinery

II - MECHANICAL ENGINEERING PRACTICE

Basic Machining:

(a) Drilling Practice (holes of various diameters - steel sheet metal, wood, hylam/plywood sheet)

Sheet Metal Work

(a) Forming & Bending
(b) Different type of joints.
- Fabrication of mobile phone metal stand
- Fabrication of electrical control panel box

Design thinking practices

To dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model, and to assemble the following components.

- Pedestal Fan head swing mechanism - Reserve mechanism (Two wheeler) - Hot Glue gun - Paper clips - Flush tank container mechanism - Hand pump – washer Mechanism

GROUP B (ELECTRICAL & ELECTRONICS ENGINEERING PRACTICE)

1. Residential house wiring, staircase wiring and tube light wiring with single phase AC two wire system.
2. Energy measurement with RLC Load.
3. Earth resistance measurement.
4. Measurement of AC parameters using CRO and half wave and Full wave rectifier.
5. Study of logic gates AND, OR, EX-OR & NOT.
6. Soldering practice – Components Devices and Circuits – Using PCB.

Design thinking practices

1. Assemble a single phase 3 wire circuit for connecting household appliances and explain through schematic diagram
2. Measure the energy consumed by the household appliances and verify it theoretically
3. Analyze the fault occurring in electrical appliances
4. Design, assemble and test a cell phone charger
5. Design, assemble and test a relay logic to control electrical appliances.
6. Design, assemble and test a dc power supply using PCB

Total Periods:45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Draw pipeline plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household woodwork (K2)
CO2: Practice machining to make holes on different materials; fabricate sheet metal components (K2)
CO3: Dismantle, understand the functional / aesthetic aspects of the product, prepare the part functional model of various components (K2)
CO4: Construct domestic electrical circuits and verify their output parameters (K3)

CO5: Construct electronics circuits and verify their output (K3)
References: 1. Willis H. Wagner, Howard "Bud" Smith, and Mark W. Huth Modern Carpentry, 12th Edition, 2015 2. P.C.Sharma, Production Technology (Manufacturing Process): Manufacturing Process, S.Chand publisher, 2006 3. Robert W. Messler, Reverse Engineering: Mechanisms, Structures, Systems & Materials, McGraw-Hill Education, 2014 4. David W Rongey , A Complete Guide to Home Electrical Wiring, 2013 5. K.Jeyachandran, S.Natarajan & S, Balasubramanian, "A Primer on Engineering Practices Laboratory", Anuradha Publications, (2007).

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	3	2		1					2	1		1
2	3	2		1					2	1		1
3	3	2		1					2	1		1
4	3	3	3	3					3	1		1
5	3	3	3	3					3	1		1

Semester - III

Course Code	Course Title	L	T	P	C
UMA2376	**TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS**	**3**	**1**	**0**	**4**

Objectives:

- Find Fourier series expansion of periodic functions
- Solve the problems in partial differential equations.
- Apply the concept of Fourier series in solving initial and boundary value problems.
- Find Fourier transform of various functions.
- Evaluate difference equations using Z- transform technique.

Unit I	**FOURIER SERIES**	**12**

Dirichlet's conditions – Fourier series – Odd and even functions – Half range sine and cosine series – RMS value - Parseval's identity – Harmonic analysis.

Unit II	**PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Solutions to partial differential equations – First order PDE's - standard types – Equations reducible to standard types - Lagrange's linear equation, Higher order PDE's – Linear homogeneous partial differential equations with constant coefficients

Unit III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation, Solutions to Heat equations - One dimensional heat equation – Two dimensional steady state heat equation (no insulated edges).

Unit IV	**FOURIER TRANSFORMS**	**12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transform of simple functions, Transform of derivatives – Convolution theorem – Parseval's identity.

Unit V	**Z - TRANSFORMS AND DIFFERENCE EQUATIONS**	**12**

Z- transforms - Elementary properties – Bilateral Z-transforms (definition only), Unit step function, Unit impulse function, Convolution theorem - Inverse Z - transform (using partial fraction, convolution theorem and residues), Discrete time systems and Difference Equations- Solution of difference equations using Z- transform.

Total Periods	**60**

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

CO1: Obtain Fourier series expansion of periodic functions.

CO2: Solve the problems in partial differential equations.

CO3: Able to solve initial and boundary value problems using Fourier series techniques.

CO4: Obtain Fourier transform of various functions

CO5: Evaluate difference equations using Z- transform technique.

CO6: application of Fourier Series, Partial differential equations, Fourier transform, and Z-transforms in engineering problems

Text Books:
1. Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, Delhi, 2018.
2. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Second reprint, New Delhi, 2012.
3. Narayanan.S., ManicavachagomPillay.T.K and Ramanaiah. G, "Advanced Mathematics for Engineering Students" Vol. II & III, S. Visvanathan Publishers Pvt Ltd. 1998.
References:
1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt Ltd, 2016.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-Graw Hill Publishing Company Limited, New Delhi, 2008.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2016.
4. Ray Wylie. C and Barrett. L.C, "Advanced Engineering Mathematics", Sixth Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, 2012.
5. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												
2	3	2												
3	3	2												
4	3	2												
5	3	2												
6	3	2										1		

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UHS2376	Universal Human Values 2: Understanding Harmony	**2**	**0**	**2**	**3**

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life Course

Unit I	INTRODUCTION TO VALUE EDUCATION	9
Value Education - Need, Basic Guidelines, Content and Process, Self-Exploration - meaning, importance and process, Continuous Happiness and Prosperity - A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities - the basic requirements, Understanding Happiness and Prosperity - A critical appraisal of the current scenario, Method to fulfill the above human aspirations - understanding and living in harmony at various levels.		
Unit II	**HARMONY IN THE HUMAN BEING**	**9**
Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya		
Unit III	**HARMONY IN THE FAMILY AND SOCIETY**	**9**
Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human to human relationship; Understanding Trust - the foundational value in relationship, Difference between intention and competence, Understanding Respect – as the right evaluation, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society - comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order - from family to world family!		
Unit IV	**HARMONY IN THE NATURE AND EXISTENCE**	**9**
Understanding the harmony in the Nature, Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature- recyclability, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.		
Unit V	**IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS**	**9**
Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics - augmenting universal human order, the scope and characteristics of people-friendly and eco-friendly, Holistic Technologies, production systems and management models - Case studies, Strategy for transition from the present state to Universal Human Order - At the level of individual: as socially and ecologically responsible engineers, technologists and managers, At the level of society: as mutually enriching institutions and organizations.		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		

CO1: Understand the significance of value education, happiness, and prosperity (K2)
CO2: Understand the significance of harmony in self and body (K2)
CO3. Understand the value of harmony in human relationships (K2)
CO4: Understand the harmony in nature and existence and work out their mutually fulfilling participation in the nature. (K2)
CO5: Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work (K4)
Text Books:
1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi, 2nd Revised Edition, 2019.
References:
1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

COs	**POs**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1						2		3	3	2		3
2						2		3	3	2		3
3						2		3	3	2		3
4						2		3	3	2		3
5						2		3	3	2		3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEC2376	**SIGNALS AND SYSTEMS**	**3**	**0**	**0**	**3**

Objectives:

- To understand the basic properties of signal & systems.
- To know the methods of characterization of LTI systems in time domain.
- To analyze continuous time signals and systems in the Fourier and Laplace domain.

• To analyze discrete time signals and systems in the Fourier and Z transform domain.		
Unit I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**	**9**
Continuous-Time signals (CT), Discrete-Time signals (DT) - Step, Ramp, Pulse, Real and complex exponentials, Sinc, Impulse, Exponential, Classification of CT and DT signals - periodic and aperiodic signals, Energy and Power signals, Random signals- Continuous-time and Discrete-time sinusoids and its properties – Operations on signals-Dependent and Independent Variables- CT systems and DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Static and Dynamic and Stable & Unstable.		
Unit II	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	9
Fourier series analysis (Exponential only)- Properties of Fourier series -Time shifting, Frequency shifting and Parseval's Theorem in Fourier series, Gibb's phenomenon. Fourier Transform and its properties - Linearity, Time shift, Time scaling, Frequency shift, Duality, Differentiation in time and frequency, Convolution, Multiplication and Parseval's Theorem. Review of Laplace transform- Pole-Zero diagram in s-domain, Region of Convergence (ROC)- Properties of ROC- Inverse Laplace transform.		
Unit III	**LINEAR TIME-INVARIANT CONTINUOUS TIME SYSTEMS**	9
Differential equation, Representing CT system using differential equations – Application of Laplace transform to RL, RC and RLC circuits- Impulse response- Causality and Stability, Convolution integral- Properties of convolution integral (Statement only)- Transfer function of CT systems-Analysis of CT systems using Fourier and Laplace transform-Interconnection of system –Cascade and Parallel.		
Unit IV	**ANALYSIS OF DISCRETE TIME SIGNALS**	9
Sampling of CT signals, Frequency domain representation of sampling, Reconstruction of a band-limited signals from its samples- Z-transform, Pole – Zero diagram in z-domain, properties of Z-transform -Linearity, Time shift, Time scaling, Time Reversal, Frequency shift, Convolution, and Correlation, Inverse Z-transform- Partial fraction method. Discrete-Time Fourier Transform (DTFT) and Inverse DTFT- Properties- Periodicity and Parseval's theorem.		
Unit V	**LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS**	9
Difference equations, Impulse response, Convolution sum, Z-transform and DTFT Analysis of Recursive & Non-recursive systems. Block diagram representation, Direct Form-I and Direct Form-II - Cascade and Parallel forms, Interconnection of DT systems – Cascade and Parallel		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Analyze the properties of signals & systems.		
CO2: Apply Fourier series, Laplace transform, Fourier transform, Z-transform and DTFT in signal analysis.		
CO3: Analyze continuous time LTI systems using Fourier and Laplace Transforms		
CO4: Analyze discrete time LTI systems using Z-transform and DTFT.		
Text Books:		

1. Oppenheim A.V, Wilsky S and Nawab S.H, Signals and Systems, Prentice-Hall International, Second Edition, 2011 (Unit I-V)

References:

1. Lathi B.P, Principles of Linear Systems and Signals, Oxford, Second Edition, 2009.
2. Zeimer R.E, Tranter W.H and Fannin R.D, Signals & Systems-Continuous and Discrete, Prentice-Hall, Fourth Edition, 1998.
3. OktayAlkin, Signals and Systems: A MATLAB® Integrated Approach, CRC Press,
4. First Edition, 2017.
5. Roberts M.J, Signals & Systems Analysis using Transform Methods & MATLAB, Tata-McGraw Hill, First Edition, 2003.
6. Luis Chaparro and Aydin Akan, Signals and Systems using MATLAB, Elsevier, Third Edition,2018.

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3		2	3				2			2	3	3	2
2	3	3		2	3				2			2	3	3	2
3	3	3	2	3	3	2	1		2			2	2	3	2
4	3	3	2	3	3	2	1		2			2	3	3	2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2301	**ELECTROMAGNETIC THEORY**	**2**	**1**	**0**	**3**

Objectives:

- To understand the basic mathematical concepts related to electromagnetic vector fields
- To study the concepts of Electrostatic fields, electrical potential, energy density and their applications.
- To study the concepts of Magneto static fields, magnetic flux density, vector potential and its applications.
- To apply concepts related to electrostatics, magnetostatics and electrodynamics in obtaining Maxwell's equations
- To understand Electromagnetic wave propagation and characterize the parameters

Unit I	**VECTOR ANALYSIS**	**9**

Sources and effects of electromagnetic fields – Coordinate Systems – Differential Elements of Length, Surface and Volume - Vector fields –Gradient of a scalar field - Divergence of a vector field - Curl of a vector filed – Gauss's Divergence Theorem - Stoke's Theorem.

Unit II	**STATIC ELECTRIC FIELDS**	**9**

Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications-Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors,

dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.		
Unit III	**STATIC MAGNETIC FIELDS**	**9**
Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media –Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.		
Unit IV	**ELECTRODYNAMIC FIELDS**	**9**
Faraday's law – Transformer and motional EMF –Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory –Electromagnetic boundary conditions - Applications of electrodynamic fields		
Unit V	**ELECTROMAGNETIC WAVES**	**9**
Electromagnetic wave equations – Wave parameters: velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth – Poynting vector.		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Apply the basic mathematical concepts related to electromagnetic vector fields.		
CO2: Examine the concepts of electrostatic fields, electrical potential, energy density and their applications.		
CO3: Infer the concepts of magneto static fields, magnetic flux density, vector potential and its applications.		
CO4: Perform analysis using concepts related to electrostatics, magnetostatics and electrodynamics in obtaining Maxwell's equations		
CO5: Understand electromagnetic wave propagation and characterize the parameters		
Text Books:		
1. Mathew N. O. Sadiku and S.V. Kulkarni, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.		
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.		
3. Salivahanan S and Karthie S, 'Electromagnetic Field Theory", 2nd Edition, McGrawHill, 2018		
References:		
1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.		
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.		
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.		

4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015.
6. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2										1	3	
2	3	2	1						1	1		1	3	
3	3	2	1						1	1		1	3	
4	3	2	1						1	1		1	3	
5	3	2	1						1	1		1	3	

Course Code	Course Title	L	T	P	C
UEE2302	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES FOR ELECTRICAL ENGINEERING	3	0	0	3

Objectives:

- To understand Object Oriented Programming concepts
- To perform polymorphism and file handling in C++
- To explore linear data structures.
- To explore non-linear data structures.
- To apply the concepts of oops and data structures to electrical engineering

Unit I	INTRODUCTION TO OBJECT ORIENTED PROGRAMMING	9

Object oriented programming concepts: classes – objects – object relations – members - abstraction - encapsulation - inheritance – polymorphism. Introduction to C++- class- static & dynamic objects - constructors – destructors- static and constant members - this pointer – inline - name space.

Unit II	OVERLOADING – POLYMORPHISM – FILES	9

Operator overloading – friend functions - Inheritance – function pointers -class pointers- virtual functions- static and runtime polymorphism - type conversions- templates - standard template library. Exception and File handling.

Unit III	LINEAR DATA STRUCTURES – LIST, STACKS & QUEUES	9

Abstract Data Types (ADTs), Linked List - Types, Implementation & applications - Polynomial manipulations. Stack - Operations & Applications - Evaluating arithmetic expressions. Queue – Operations - Types: Circular Queue - Priority Queue – deQueue -

Applications of Queues.		
Unit IV	**NON LINEAR DATA STRUCTURES – TREES & GRAPHS**	9
Tree ADT, Binary Tree – search, Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of trees & heap. Graphs: Representation – Types - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.		
Unit V	**ALGORITHMS & APPLICATIONS OF OOPS & DATA STRUCTURES TO ELECTRICAL ENGINEERING**	9
Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort – Shell sort – Radix sort. Applications - Solutions to simple DC/AC Circuits using Graphs. Solutions to simple Digital Circuits – Full Adder, four-bit full adder using OOPs. Solutions to simple power system problems.		
	Total Periods	45

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

CO1. Describe the need for object-oriented programming.

CO2. Apply the concepts of polymorphism, inheritance, exception, and file handling in programming.

CO3. Illustrate the implementation of linear data structures using list, stacks, and queues.

CO4. Apply the concepts of non-linear data structures in programming.

CO5. Illustrate various sorting and search algorithms for data handling

CO6. Emulate electric circuits using OOPS and data structures.

Text Books:

1. B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007.
2. Cay S. Horstman, Gary Cornell, “Core JAVA volume 1”, Eighth Edition, Pearson Education, 2008.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education,1997.
4. Reema Thareja, “Data Structures Using C”, Second Edition, Oxford University Press, 2011

References:

1. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGraw-Hill Publishing Company Ltd., 2007.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Premier”, Fourth Edition, Pearson Education, 2005
3. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
5. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”,Second Edition, University Press, 2008

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		2		3								3	
2	3		2	1	3								3	
3	3		2	1	3								3	
4	3		2	1	3								3	
5	3		2	3	3								3	

Course Code	Course Title	L	T	P	C
UEE2303	**ELECTRONIC DEVICES AND CIRCUITS**	**3**	**0**	**0**	**3**

Objectives:

- Understand the structure of basic electronic devices.
- Familiarize the operation and characteristics of transistor like BJT and MOSFET.
- Explore the design and analysis of amplifiers and understand the frequency response of amplifiers.
- Learn the required functionality of positive and negative feedback amplifiers.

Unit I	**DIODE AND IT'S APPLICATIONS**	**9**

PN junction diode – Structure, Operation, VI characteristics, models; Applications - Half wave rectifier, Full wave rectifier, impact of filters; Zener diode – Breakdown characteristics, Voltage regulation; Varactor diode, Light emitting diode (LED), Schottky diode – Operation and Applications.

Unit II	**TRANSISTORS AND THYRISTORS**	**9**

Transistors: BJT, UJT, FET, MOSFET – Structure, Operation, Input-output characteristics; Biasing methods of BJT, FET & MOSFET; Thyristors: Structure, Operation and VI characteristics

Unit III	**SMALL SIGNAL AND LARGE SIGNAL AMPLIFIERS**	**9**

BJT–Configurations, Small signal analysis using hybrid model – Analysis of CE amplifiers, Frequency response; MOSFET – Configurations, Small signal models, Analysis of CS and Source follower amplifiers; Power amplifiers - Class A, Class B, Class AB, Class C and Class D amplifiers (Qualitative analysis only).

Unit IV	**MULTISTAGE AND DIFFERENTIAL AMPLIFIERS**	**9**

Introduction to Multistage amplifiers, Different coupling methods and their frequency response, Darlington connection; Differential Amplifier – Common mode analysis, Differential mode analysis, CMRR, frequency response; Single tuned and double tuned amplifiers- Operation and frequency response.

Unit V	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9**

Feedback amplifiers - Types, Stability, Distortion; Negative feedback: Voltage/current, series/shunt feedback amplifiers; Positive feedback: Barkhausencriterion, Operation and analysis of RC phase shift, Wienbridge, Hartely, Colpitts and crystal oscillators; Non-sinusoidal oscillators: Astable, Monostable & bistable Multivibrators.
Total Periods 45
Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Describe the operation, characteristics and applications of diodes
CO2: Describe the operation, characteristics and applications of transistors
CO3: Design and analyze BJT and MOSFET amplifiers through frequency response
CO4: Design and analyze multistage and differential amplifiers through frequency response
CO5: Design feedback circuits for amplifier and describe various oscillators and its stability
Text Books:
1. Electronic Devices- Floyd T.L, 9th Edition, Pearson Education, 2012.
2. Electronic Devices and Circuits – S.Salivahanan, N.Suresh Kumar, Mcgraw Hill Education, New Delhi, Fourth Ed, 2016.
3. Electronic Devices and Circuits – David A. Bell, 7th Ed, Oxford, 2008
References:
1. Electronic devices and circuits – Allen Mottershead, Goodyear Publishing company,1973.
2. Electronic Devices and Circuits – B. P. Singh, Rekha Singh, Pearson, Second Ed, 2013.
3. Electronic Devices and Circuits – Anil K. Maini, VarshaAgarwal, First Ed, Wiley India Pvt. Ltd, 2009.
4. Millman's Electronic Devices and Circuits – J. Millman, C.C.Halkias and Satyabratajit, Second Ed,1998, TMH.
5. Electronic Devices and Circuits – Mohammad Rashid, Cengage Learing, 2013

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			2									1	3
2	3												1	3
3	3	2	3	3	2							1	1	3
4	3			2									1	3
5	3			2	1								1	3

Course Code	Course Title	L	T	P	C
UEE2311	ELECTRONICS LAB	0	0	3	1.5

Objectives:

- To enable the students to understand the behavior of semiconductor device based on experimentation.

List of Experiments:

1. Study of CRO for frequency and phase measurements
2. Characteristics of Semiconductor diode and Zener diode
3. Characteristics of a NPN Transistor under common emitter, common collector and common base configurations
4. Characteristics of JFET and draw the equivalent circuit
5. Characteristics of UJT and generation of saw tooth waveforms
6. Design and Frequency response characteristics of a Common Emitter amplifier
7. Characteristics of photo diode & photo transistor, Study of light activated relay circuit
8. Design and testing of RC phase shift and LC oscillators
9. Single Phase half-wave and full wave rectifiers with inductive and capacitive filters10. Differential amplifiers using FET
11. Realization of passive filters

Total Periods:45

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

CO1: Characterize PN diode, zener diode, BJT, FET , UJT, photo diode and photo transistor.

CO2: Characterize rectifiers, passive filters, CE amplifiers and differential amplifiers.

CO3: Characterize oscillators and realize filters.

References:

1. Electronic Devices- Floyd T.L, 9th Edition, Pearson Education, 2012.
2. Electronic Devices and Circuits – S.Salivahanan, N.Suresh Kumar, Mcgraw Hill Education, New Delhi, Fourth Ed, 2016.
3. Electronic Devices and Circuits – David A. Bell, 7th Ed, Oxford, 2008

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	1	3				1	3	1		1	2	3
2	2	2	1	3				1	3	1		1	2	3
3	2	2	1	3				1	3	1		1	2	3

Course Code	Course Title	L	T	P	C
UEE2312	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES LABORATORY FOR ELECTRICAL ENGINEERING	0	0	3	1.5

Objectives:

- Object orient programming & Inheritance
- Polymorphism & File handling
- Linear & non-linear data structures.
- Searching & Sorting.
- Solutions to electrical engineering problems

List of Experiments:

1. Simple classes for understanding objects (Both static and dynamic objects), member functions, constructors & destructors.
2. Classes with both Static and Constant members
3. Compile time Polymorphism – Operator and Function Overloading.
4. Runtime Polymorphism – Inheritance, Virtual Functions and Templates
5. File Handling – Sequential and Random
6. Creation, Insertion, Deletion and Traversal in Linked List – Singly, Doubly and Circular
7. Implementation of Queues – Arrays and Liked List
8. Implementation of Stacks – Arrays and Linked List
9. Insertion, Deletion and search in a binary search tree.
10. Implement Bubble Sort Quick sort and Heap sort
11. Application of graphs for solving DC/AC Circuits
12. Application of OOPS for solutions to digital circuits.

Total Periods:45

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

CO1: Develop software skills for real time programming using the concept of oops.

CO2: Understand and apply the concepts of Inheritance, Exception and File handling.

CO3: Understand and apply the concepts of Linear Data structures

CO4: Understand and apply the concepts Non Linear Data structures

CO5:Apply the concepts of oops and data structures to Electrical Engineering.

References:

1. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGraw-Hill Publishing Company Ltd., 2007.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Premier”, Fourth Edition, Pearson Education, 2005
3. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
5. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”,Second Edition, University Press, 2008.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		2		3								3	
2	3		2	1	3								3	
3	3		2	1	3								3	
4	3		2	1	3								3	
5	3		2	3	3								3	

Semester – IV

Course Code	Course Title	L	T	P	C
UMA2452	PROBABILITY AND STATISTICS FOR ELECTRICAL ENGINEERING	2	1	0	3

Objectives: The objective of this course is to enable the student to

- Identify the standard distributions and apply them in solving problems.
- Solve problems in joint probabilities and to find correlation between them.
- Perform hypothesis testing using normal, t, F, chi square distribution
- Evaluate the tests of significance in analysis of variance.
- Calculate the various statistical quality control measurements

Unit I	**RANDOM VARIABLES**	**9**
Random Variables - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Uniform, Exponential, Normal distributions		
Unit II	**TWO-DIMENSIONAL RANDOM VARIABLES**	**9**
Joint distributions - Marginal and Conditional distributions - Covariance - Correlation and Linear regression		
Unit III	**TESTS OF SIGNIFICANCE**	**9**
Sampling distributions - small and large sample test - Test based on Normal and t distribution (Single and difference of mean) - χ^2-Test for goodness of fit, Independence of attributes- F test for variance.		
Unit IV	**DESIGN OF EXPERIMENTS**	**9**
One way and two-way classifications, Completely randomized design, Randomized block design, Latin square design		
Unit V	**STATISTICAL QUALITY CONTROL**	**9**
Control charts for measurements ($\bar{X}$ and R charts) - Control charts for attributes (p, c and np charts) - Tolerance limits - Acceptance sampling		
	Total Periods	45

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

CO1: Identify standard distributions and apply them.

CO2: solve problems in two dimensional random variables and find the correlation

between them.
CO3: Identify and apply the suitable testing of hypothesis under normal, t, F and chi square distribution
CO4: Solve problems in analysis of variance.
CO5: Analyze quality control by applying control chart methods.
CO6: Application of Design of Experiments in engineering problems
Text Books:
1. Milton, J. S. and Arnold, J.C., Introduction to Probability and Statistics, Tata McGraw-Hill, New Delhi, 4th Edition, 2014.
2. Johnson, R.A. and Gupta, C.B., Miller and Freund's Probability and Statistics for Engineers, Pearson Education, Asia, 9th Edition, 2016.
References:
1. Devore, J.L., Probability and Statistics for Engineering and the Sciences, Thomson Brooks/Cole, International Student Edition, New Delhi, 8th Edition, 2012.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9th Edition, 2012.
3. Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists, Elsevier, New Delhi, 5th Edition, 2014.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., Schaum's Outline of Theory and Problems of Probability and Statistics, Tata McGraw Hill, New Delhi, 3rd Edition, 2017.
5. Gupta, S.C and Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan and Chand Company, New Delhi, 12th Edition, 2020.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												
2	3	2												
3	3	2												
4	3	2		1										
5	3	2												
6	3	2										1		

Course Code	**Course Title**	**L**	**T**	**P**	**C**
AHS2476	**INDIAN CONSTITUTION**	3	0	0	0

Objectives:

- To teach history and philosophy of Indian constitution.
- To summarize powers and functions of Indian government.
- To explain structure and functions of local administration.

- To demonstrate the organization and working of the Judiciary.
- To discuss financial power and emergency provisions.

Unit I	**INTRODUCTION**	**9**
Historical background – Government of India act – Indian councils act – Making of the constitution -Philosophy of the Indian constitution – Preamble.		
Unit II	**GOVERNMENT OF THE UNION**	9
Powers and Functions of President and Prime Minister - Council of Ministers – President in relation to his council - Legislature structure and functions of LokSabha and RajyaSabha – Speaker.		
Unit III	**GOVERNMENTS OF THE STATES AND LOCAL GOVERNMENT**	9
The state executive: General structure – Governor – Council of ministers – State legislature.Local government - Panchayat –Municipality– Power authority and responsibilities municipalities.		
Unit IV	**THE JUDICATURE**	9
Organization and Composition of Judiciary – Constitution – Appointment - Qualifications - Powers and functions of the supreme court– High courts – Control over subordinate courts.		
Unit V	**THE FEDERAL SYSTEM**	9
Distribution of financial powers: Need, principles-Underlaying distribution of tax revenues-Distribution of legislative power – Interstate relation - Emergency provisions.		
	Total Periods	45

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

CO1: Understand history and philosophy of Indian constitution.

CO2: Realize powers and functions of Indian government.

CO3: Acquire awareness on structure and functions of local administration.

CO4: Enhance knowledge about organization and composition of judiciary.

CO5: Explore the distribution of financial powers and emergency provisions.

Text Books:

1. Basu D.D, “Introduction to Indian Constitution”, Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, “Indian Government and Politics”, Vikas Publishing House, New Delhi, 2010.

References:

1. Pylee M.V, “Introduction to the Constitution of India”, Vikas Publishing House,NewDelhi, 2011.
2. Kashyap S, “Our Constitution”, National Book Trust, New Delhi, 2010.
3. The Constitution of India, 1950 (Bare Act), Government Publication.
4. Jain M P, Indian Constitution Law, 7thEdition., Lexis Nexis, 2014.
5. Busi S N, Ambedkar B R framing of Indian Constitution, 1stEdition, 2015.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1						2		2	2	2		2		
2						2		2	2	2		2		
3						2		2	2	2		2		
4						2		2	2	2		2		
5						2		2	2	2		2		

Course Code	Course Title	L	T	P	C
UEE2401	ELECTRICAL MACHINES-I	3	0	0	3

Objectives:

- To know about the principles of electromechanical energy conversion in singly and multiply excited systems.
- To study the construction, working principles and characteristics of DC generator and DC motor
- To understand the starting process, speed control methods and tests of DC motors.
- To realize the constructional details, principle of operation, prediction of performance, testing methods of single phase transformer
- To know about three phase transformer connections and instrument transformers.

Unit I	MAGNETIC CIRCUITS	9

Basic magnetic circuit analysis - Magnetization characteristics (BH curves) – BH loop - hysteresis and eddy-current losses. Magnetically induced EMF and force – Energy in magnetic system - field energy and mechanical force – electromagnetic energy conversion - singly and doubly excited magnetic field systems.

Unit II	DC GENERATOR	9

Constructional features of DC machines - lap and wave windings - principle of operation - EMF equation – types of DC generators – commutation - Armature reaction - interpoles - voltage regulation - external and internal or total characteristics - Parallel operation of Generators.

Unit III	DC MOTOR	9

Principle of operation, types of DC motors – Torque and speed of DC motor – Electrical and Mechanical characteristics - Starting, speed control and braking of DC motors - Parallel operation of motors - Losses in DC machines, Efficiency- Swinburne's and Hopkinson's test – Permanent magnet DC motors (PMDC) and its applications.

Unit IV	TRANSFORMER	9

Working principle-Construction, Core-type and Shell type transformers- ideal transformer, EMF equation, performance of transformer on no load and loaded conditions - Phasor diagrams - Equivalent circuit – open circuit and short circuit test - Voltage regulation -

efficiency and losses- Sumpner Test - all day efficiency - Auto transformer - Parallel operation of single-phase transformer.		
Unit V	**TRANSFORMER: THREE PHASE**	9
Three phase transformer connections – Open Delta Connection- Scott connections. Three-phase to single phase conversion- parallel operation of three phase transformers. Instrument Transformers – Current Transformer, Potential Transformer		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Apply the principles of electromechanical energy conversion in singly and multiply excited systems.		
CO2: Describe the construction, working principle and characteristics of DC generator		
CO3: Illustrate various speed control methods, necessity of starters and performance assessment of DC motor.		
CO4: Analyze the performance of single phase transformers		
CO5: Describe the principle of various three phase transformer and instrument transformers		
CO6: Design and evaluate the suitability of DC machines and transformers for the given application.		
Text Books:		
1. Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004		
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.		
References:		
1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.		
2. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.		
3. B.L.Theraja and A.K.Theraja, 'A Textbook of Electrical Technology Vol II AC and DC Machines.		
4. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.		
5. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition, 2009.		
6. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.		
7. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.		

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	2						1		1	1	3
2	3	2	1	2						1		1	1	3
3	3	2	1	2						1		1	1	3
4	3	2	1	2						1		1	1	3
5	3	2	1	2						1		1	1	3

Course Code	Course Title	L	T	P	C
UEE2402	ANALOG ELECTRONIC CIRCUITS	3	0	0	3

Objectives:

- To familiarize the signal analysis using Op-amp based circuits.
- To understand the applications of Op-amp.
- To study the functional blocks and applications of special ICs like Timers, PLL circuits, regulator circuits.
- To know the IC fabrication procedure.

Unit I	IC FABRICATION	9

IC classification, fundamental of monolithic IC technology – basic silicon planar processes including packaging, Fabrication of typical circuit, Fabrication of resistors, capacitors, diodes and FETs, Thin and Thick film technology.

Unit II	CHARACTERISTICS OF OPAMP	9

Functional block diagram of op-amp IC741, Ideal op-amp characteristics, DC characteristics, AC characteristics, frequency compensation and stability of op-amp, slew rate, Differential amplifier, Basic applications of op-amp – Inverting and non-inverting amplifiers, voltage follower.

Unit III	APPLICATIONS OF OPAMP	9

Summer, Differentiator & Integrator, Voltage to Current and Current to Voltage converters, Instrumentation amplifier, Log and Antilog Amplifiers. Characteristics of filters, First and second order active Butterworth filters. Comparators, Multivibrators, Waveform generators, Clippers, Clampers, Peak detector, Sample & Hold circuit. DAC (R- 2R ladder, Inverted R-2R & Weighted resistor) and ADC (Flash, Successive approximation, Dual slope) using op-amps, Specifications.

Unit IV	SPECIAL ICs	9

Functional block, characteristics, modes & applications of 555 Timer IC, 566 voltage controlled oscillator IC, 565-phase lock loop IC, Analog multiplier ICs.

Unit V	APPLICATION ICs	9

IC voltage regulators – Fixed voltage regulators LM78XX & LM79XX - Variable voltage regulators LM317 & IC723, Concept of Switching regulator- Schematic diagram & function of SMPS- LM 380 power amplifier- ICL 8038 function generator IC.

Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1. Describe the IC fabrication steps and their integrated sequence to fabricate Silicon devices and ICs.
CO2. Describe the Characteristics of Op-amps.
CO3. Design the Op-amp circuits for basic applications with feedback using passive components and diodes.
CO4. Design the Op-amp circuits for reasonably complex applications such as multivibrators, filters and oscillators.
CO5. Illustrate the internal functional blocks and the applications of special ICs like Timers, PLL, Regulator, Analog Multiplier, etc.
Text Books:
1. D. Roy Choudhury, Shail B. Jain, 'Linear Integrated Circuits', II edition, New Age, 2003.
2. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI, 2000
References:
1. S. Salivahanan and V. S. Kanchana Bhaaskaran, " Linear Integrated Circuits" McGraw Hill Edition, New Delhi, 2nd edition, 2018.
2. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
3. Fiore,"Opamps& Linear Integrated Circuits Concepts & Applications", Cengage, 2010.
4. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
5. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2003.
6. Robert F. Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', PHI Learning, 6th edition, 2012.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3											1	1	3
2	3												1	3
3	3		2	1								1	1	3
4	3	1	3	1	2							1	1	3
5	3												1	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2476	**CONTROL SYSTEMS ENGINEERING**	**3**	**0**	**0**	**3**

Objectives:

- To explain the importance of transfer function in modelling physical systems
- To analyse any system with respect to time domain and frequency domain
- To explain the stability of the system

- To Design and analyse a compensator system and PID Controller to meet the desired specifications and to improve the stability of the system.

Unit I	**SYSTEMS AND THEIR REPRESENTATION**	**9**

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Synchros – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs

Unit II	**TIME RESPONSE**	9

Time response – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis - Implementation using MATLAB

Unit III	**FREQUENCY RESPONSE**	9

Frequency response – Bode plot – Polar plot – Nyquist plot- Constant M - N circles - Nichols Chart- Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications- Implementation using MATLAB

Unit IV	**STABILITY AND COMPENSATOR DESIGN**	9

Characteristics equation – Routh Hurwitz criterion – Performance criteria – Lag, lead and lag-lead networks – Effect of Lag, lead and lag-lead compensation on frequency response analysis - Design of compensator network using Bode plot.- Implementation using MATLAB

Unit V	**STATE VARIABLE ANALYSIS**	9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Implementation using MATLAB

Total Periods	45

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

CO1: Derive transfer function for a given physical system (K3)

CO2: Analyse a system in both time domain and frequency domain (K3)

CO3: Determine the stability of a given system (K3)

CO4: Design and analyse a compensator for a given system specification (K4)

CO5: Design a controller to improve the stability of a given system (K3)

Text Books:

1. S.Salivahanan, R.Rengaraj, and G.R.Venkatakrishnan, "Control systems Engineering", Pearson India Education, 2015.
2. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
3. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

References:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson India Education, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson India Education,2009.

3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
4. RamesC.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3				1								3	2
2	3	3		2									3	2
3	3	3		2									3	2
4	3	3		2									3	2
5	3	3	3	2	3								3	2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2403	**GENERATION TRANSMISSION AND DISTRIBUTION**	4	0	0	4

Objectives:

- To introduce various electric power generation principle along with computation of electric power tariff.
- To determine the various electrical parameter and to compute electrical performance of overhead transmission line
- To explain the role of insulators in OHTL and underground cables.
- To study about DC and AC distribution systems along with various techniques for voltage and power factor improvement.

Unit I	**GENERATION PRINCIPLES**	**12**

Hydro-electric power plants - Thermal power plants - Nuclear power plants – Renewable Power Plant – Operation – Selection of Site - Power tariff types

Unit II	**TRANSMISSION LINE PARAMETER**	12

Structure of electric power system - Types of AC and DC distributors - EHVAC and HVDC transmission - Resistance, Inductance and Capacitance calculations – Single-phase and three phase lines – double circuit lines – effect of earth on transmission line capacitance - corona & proximity effect

Unit III	**PERFORMANCE OF TRANSMISSION LINE**	12

Modeling of Transmission Line - short, medium and long transmission lines - Regulation and efficiency – ABCD constants - Power flow through a transmission line - surge

impedance loading – Ferranti effect		
Unit IV	**MECHANICAL DESIGN OF TRANSMISSION LINE AND CABLES**	12
Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers Insulators, Voltage distribution in suspension insulators – string efficiency – improving string efficiency - testing of insulators Underground cables – Types of cables – insulation resistance – dielectric stress – grading of cables - capacitance grading - intersheath grading.		
Unit V	**DISTRIBUTION SYSTEMS**	12
General aspects – DC distribution systems - concentrated and distributed loads - radial and ring main systems – A.C. distribution – Single-phase and three phase		
	Total Periods	60
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Understand the principles of power generation and various power tariff.		
CO2: Determine the various transmission line parameters.		
CO3: Analyze the performance of overhead transmission line.		
CO4: Compute the voltage distribution, string efficiency, and dielectric stress for OHTL and Cables.		
CO5: Analyze the performance of DC and AC distribution systems		
CO6: Evaluate and Summarize the concepts of transmission and distribution for a specific real time problem.		
Text Books:		
1. Leonard L. Grigsby, “Electric Power Generation, Transmission, and Distribution”, CRC Press; 1st edition, 2007.		
2. Wadhwa, C.L., ‘Generation Distribution and Utilization of Electrical Energy', New Age International Publishers, 3rd Edition, 2010.		
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India, Second edition 2008.		
References:		
1. S. Sivanagaraju and S. Sathyanarayana, 'Electric Power Transmission and Distribution', Pearson, 2009.		
2. V.K. Mehta and Rohit Mehta, ' Principles of Power System', S. Chand, 2013		
3. C L Wadhwa, “Electrical Power Systems”, New Age Internationals; First Edition 2016		
4. Gupta B.R., 'Power system Analysis & Design', S. Chand and Company Ltd., Re-issue Edition, 2005.		

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3		1	3			1						
2	3	3	2	1	3			1						
3	3	3	2	1	3			1					1	
4	3	3	2	1	3			1						
5	3	3		1	3			1						

Course Code	Course Title	L	T	P	C
UEE2411	ELECTRICAL MACHINES LAB-I	0	0	3	1.5

Objectives:

- To obtain practical knowledge in the characteristics of DC generators
- To gain practical knowledge in the characteristics DC motors
- To acquire practical knowledge in the characteristics of transformers

List of Experiments:

1. Open circuit and load characteristics of DC shunt generator
2. Load characteristics of DC compound generator
3. Load characteristics of DC series generator
4. Load characteristics of DC shunt and compound motor
5. Load characteristics of DC series motor
6. Swinburne's test and speed control of DC shunt motor
7. Hopkinson's test
8. Load test on single phase transformer
9. Load test on three phase transformer
10. Open circuit and short circuit tests on single phase transformer
11. Sumpner's test
12. Separation of no-load losses in single phase transformer

Total Periods:45

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

CO1: Characterize DC shunt, series and compound generators through measurements and interpretation.

CO2: Characterize DC shunt, series and compound motors through measurements and interpretation.

CO3: Characterize single phase and three phase transformers through measurements and interpretation.

CO4: Characterize DC motors and transformers under no-load condition

References:

1. Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.
4. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.
5. B.L.Theraja and A.K.Theraja, 'A Textbook of Electrical Technology Vol II AC and DC Machines.
6. B.R. Gupta,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
7. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition, 2009.
8. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.
9. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.

COs	POS												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	2	1	3				1	3	1			2	3
2	2	2	1	3				1	3	1			2	3
3	2	2	1	3				1	3	1			2	3

Course Code	Course Title	L	T	P	C
UEE2412	**ANALOG ELECTRONIC CIRCUITS LAB**	0	0	3	1.5

Objectives:

- To design and test the applications of Op-amps.
- To learn the basic modes of IC555 ICs.
- To design and test additional applications of analog ICs using software

List of Experiments:

1. Measurement of input bias current, input offset current and input offset voltage of Op-Amp IC.
2. Measurement of slew rate of μA741 IC
3. Testing of basic Op-amp applications using IC741: inverting and non-inverting amplifiers, & voltage follower
4. Testing of Adder, Subtractor and comparator circuits using Op-amp
5. Testing of Integrator and Differentiator circuits using Op-amp.
6. Timer NE/SE555applications: Astable, Monostable Operations.

7. Study of DC Characteristics of two different Op-amp packages using simulation software.
8. Study the frequency response of Op-amp IC.
9. Comparative study of differential amplifier and Instrumentation amplifier using Op-Amps.
10. Study of waveform generators using Op-amp: Sine, Triangular & Square.
11. Study of VCO & PLL.

Total Periods: 45

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

CO1: Characterize IC741 Op-Amp and realize various applications

CO2: Realize astable and monostable multivibrators using IC555 timer

CO3: Use the software simulators like PSpice for analysis of analog ICs.

References:

1. D. Roy Choudhury, Shail B. Jain, 'Linear Integrated Circuits', II edition, New Age, 2003.
2. Ramakant A. Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI, 2000

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		3						2				1	
2	3		2						2				2	1
3	3	2	3	2	2				2			1	2	1

SEMESTER V

Course Code	Course Title	L	T	P	C
UEE2501	**POWER ELECTRONICS**	**3**	**0**	**0**	**3**

Objectives:

- To understand the characteristics of power semiconductor devices
- To understand the operation of AC-DC, DC-DC, DC-AC and AC-AC power converters

Unit I	**POWER SEMI-CONDUCTOR DEVICES**	**9**

Study of switching devices - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT, Static characteristics - SCR, MOSFET and IGBT, Introduction to Silicon carbide (SiC) devices, Triggering and commutation circuit for SCR, Introduction to Driver and snubber circuits.

Unit II	**PHASE-CONTROLLED CONVERTERS**	**9**

2-pulse, 3-pulse and 6-pulse converters– performance parameters –Effect of source inductance - Firing Schemes for converter–Dual converters, Applications-light dimmer, Excitation system, Solar PV systems.

Unit III	**DC TO DC CONVERTERS**	**9**

Control strategy, Step-down and step-up chopper, Types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, switching loss calculations. Introduction to Resonant Converters, Applications-Battery operated vehicles.		
Unit IV	**INVERTERS**	**9**
Single phase and three phase voltage source inverters (both120 mode and 180 mode)– Voltage & harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, selective harmonic elimination – Introduction to space vector modulation –Single-phase Current source inverter, Applications-Induction heating, UPS.		
Unit V	**AC TO AC CONVERTERS**	**9**
Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control –Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Describe the characteristics of power semiconductor devices		
CO2: Analyse the operation and performance of phase-controlled rectifiers		
CO3: Examine the operation and control of DC – DC converters		
CO4: Discuss the operation and switching strategies of DC – AC and AC – AC converters		
CO5: Select an appropriate power converter and illustrate its characteristics for specific applications		
Text Books:		
1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third Edition, New Delhi, 2004.		
2.P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.		
References:		
1. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.		
2. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Edition, 2013.		
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.		
4. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.		
5.Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.		
6.S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.		
7. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.		
8. JP Agarwal," Power Electronic Systems: Theory and Design" 1e, Pearson Education, 2002.		

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1		1	1	1									2
2	3		2	2	2								1	3
3	3		2	2	2								2	3
4	3		2	2	2								1	2
5	3		2	2	2									2

Course Code	Course Title	L	T	P	C
UEE2502	**ELECTRICAL MACHINES II**	**3**	**0**	**0**	**3**

Objectives:

- To introduce various types of AC Electrical Machines and fractional KW motors
- To familiarize the construction and performance of synchronous generators and synchronous motor.
- To study the construction, working principle and performance of single and three phase induction machines.
- To understand the starting and speed control of three-phase induction motors.
- To study the construction, principle of operation and performance of fractional KW motors.

Unit I	**FUNDAMENTALS OF AC MACHINES**	**9**

Types of AC Machines: Synchronous machines and Induction machines - Components of rotating AC machines - stator, rotor and armature windings - Generated EMF of AC winding - Distribution factor - Chording factor - MMF of distributed windings - Magnetic field in rotating machinery - Concept of rotating flux - Relationship between electrical frequency and the speed of rotating magnetic field.

Unit II	**SYNCHRONOUS GENERATORS**	**9**

Basic principle - types- salient and cylindrical pole rotor, equivalent circuit - EMF equation armature reaction - alternator on load - synchronous reactance - voltage regulation - EMF, MMF, ZPF and A.S.A methods - power developed by a synchronous generator - power - angle characteristics - Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input - Two reaction theory.

Unit III	**SYNCHRONOUS MOTOR**	**9**

Principle of operation - Equivalent circuit - Power and Torque equation - phasor diagrams - V and inverted V curves - Method of Starting - Current loci for constant power input, constant excitation and constant power developed – Hunting – natural frequency of oscillations – damper windings- synchronous condenser.

Unit IV	**INDUCTION MOTOR**	**9**

Principle of operation - Types - Squirrel cage rotor - slip ring rotor - slip - cogging and

crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency - parameter determination from no-load and blocked rotor tests - Circle Diagram Starting and speed control-Braking Methods-Induction generator.		
Unit V	**SINGLE PHASE INDUCTION AND SPECIAL MOTORS**	**9**
Double revolving field theory – Equivalent circuit – Starting methods of single-phase induction motors – Constructional features and Working principle: Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Repulsion motor - AC series motor - Universal motor - Reluctance motor - Hysteresis motor.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Explain the fundamentals of AC machines and the basic principles of emf, mmf generation in the machine windings.		
CO2: Acquire knowledge on the constructional features, working and performance evaluation methods of synchronous machines		
CO3: Describe the construction, principle and analyze performance characteristics of three phase induction motors.		
CO4: Explain the constructional features of single-phase induction motors and other fractional KW motors.		
CO5: Evaluate the performance of synchronous and induction machines to assess suitability for domestic and industrial applications.		
Text Books:		
1.Nagrath, I.J. and Kothari.D.P., Electric Machines', McGraw-Hill Education, 2004		
2. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.		
References:		
1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.		
2. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.		
3.B.L.Theraja and A.K.Theraja, 'A Textbook of Electrical Technology Vol II AC and DC Machines		
4. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition, 2009		
5. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015		
6. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013		
7. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.		

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1									1	1	3
2	3	2	1	2								1	1	3
3	3	2	1	2								1	1	3
4	3	2	1	2								1	1	3
5	3	2	1	2	1		1		1	1		1	1	3

Course Code	Course Title	L	T	P	C
UEE2503	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION SYSTEMS	3	0	0	3

Objectives:

To impart knowledge on the following Topics

- Basic functional elements of instrumentation
- Fundamentals of electrical and electronic instruments
- Comparison between various measurement techniques
- Various storage and display devices
- Various transducers and the data acquisition systems

Unit I	INTRODUCTION	9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration- Principle and types of analog and digital voltmeters, ammeters.

Unit II	ELECTRICAL AND ELECTRONIC INSTRUMENTS	9

Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase

Unit III	COMPARATIVE METHODS OF MEASUREMENTS	9

D.C and A.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference& screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.

Unit IV	STORAGE AND DISPLAY DEVICES	9

Magnetic disk and tape recorders, Graphic recorder, Oscillographic recorder, digital plotters and printers, Cathode ray oscilloscope (CRO), CRT display, digital CRO, LED, LCD & Dot

matrix display – Data Loggers.		
Unit V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**	**9**
Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.		
	Total Periods	**45**

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

CO1: Explain the basic functional elements of any electrical and electronic instrument

CO2: Compare various principles and techniques involved in measurement

CO3: Illustrate the concept of different storage and display devices

CO4: Demonstrate the knowledge about various transducers and data acquisition systems

CO5: Identify an appropriate instrument for a particular application

Text Books:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2010.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.
4. S. Salivahanan, R. Rengaraj, G. R. Venkatakrishnan, " Measurements and Instrumentation" McGraw Hill, 2018.

References:

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, 'Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

	POs												**PSOs**	
COs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												3	
2	3	2		2									3	
3	3			2									3	
4	3			2									3	
5	3		3	3		2						3	3	2

Course Code	Course Title	L	T	EL	P	C
UEE2504	**DIGITAL LOGIC SYSTEM DESIGN AND PRACTICES**	**3**	**0**	**3**	**1**	**4.5**

Objectives:

- To study Boolean functions and combinational circuits.
- To design various synchronous circuits.
- To introduce asynchronous sequential circuits and PLDs.
- To introduce algorithmic state machine and data paths.
- To introduce design of control unit and small processor

Unit I	**DIGITAL PRINCIPLES & COMBINATIONAL LOGIC**	**9+3**

Boolean Algebra- Abstraction of Gates- Minimization: K Map & Quine-McCluskey – Boolean Arithmetic's- Combinational Circuits, Fundamentals of Microprocessor Architecture. Introduction to FPGA & VHDL.

Practice – Design and testing of Multi-input and Multibit-input - Gates, Multiplexer, Demultiplexer using VHDL.

Design and testing of Adders, Subractors, Comparators, Encoders & Decoders using VHDL.

Studio - Design and Implement 16-bit Arithmetic and logic Unit using VHDL in FPGA

Unit II	**SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS**	**9+3**

Clock-Flip-Flops-Concept of State: Table, Diagram, Reduction & Assignment – Design of Synchronous Sequential circuits using Mealy & Moore Models

Practice – Design and testing of Flip-Flops, Shift Registers, Free running Counters & Sequence Detectors using VHDL

Studio - Design and Implement 16-bit Program Counter Unit using VHDL in FPGA

Unit III	**ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS**	**9+3**

Transition table – Primitive flow table – Implication Table - Race condition – Hazards – Analysis of Asynchronous Sequential Logic Circuits – Realization of Flip flops. Introduction to Programmable Logic Devices: PROM, PLA, PAL & CPLD

Practice - Design of Asynchronous Sequential Circuits – Ripple counter, modulo counter using VHDL

Studio - Design of a Real-Time PWM signal Generation with counter using VHDL in FPGA.

Unit IV	**ALGORITHMIC STATE MACHINE & DATA PATHS**	**9+3**

ASM Chart – ASM Transition & Excitation Tables- ASM Realizations – gates, Multiplexers, PLAs & PROMS. Synchronous Sequential Circuit Design using ASM Chart- Data paths: Simple Arithmetic operation, Multiple Arithmetic Operations- -Design of Dedicated Data Paths – Simple IF THEN ELSE, Counting 1-to-n, Summation n down to 1 and factorial of n.

Practice – Design and testing of BCD to 7Segment converter using VHDL.

Studio - Design and Implement a Digital logic circuit for measuring speed using Encoder using VHDL in FPGA.		
Unit V	**DESIGN OF CONTROL UNIT & DEDICATED MICROPROCESSORS**	**9+3**
Deriving control words for Data Paths-Design of control unit- Simple IF THEN ELSE, Counting 1-to-n, Summation n down to 1. Generating status signals. Standalone controllers. Design of Dedicated Microprocessor - Largest numbers, Summation of Unsigned numbers & Greatest common devisor. **Practices** – VHDL Design of Dedicated Data paths & Control units for IF THEN ELSE, Counting, Summation procedures. **Studio**- Design and Implement an Instruction Decoder using VHDL in FPGA.		
Total Periods		**60**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Understand the digital principles and design of combinational logic circuit using VHDL.		
CO2: Analysis and design of synchronous sequential logic circuits.		
CO3: Analysis and design of Asynchronous Sequential Circuits.		
CO4: Understanding the concept of ASM and Data paths for Synchronous Sequential Circuit design.		
CO5: Design of customized microprocessor.		
Text Books:		
1.Donald D Givone, 'Digital Principals and Design', Tata McGraw-Hill, 2009.		
2. Enoch O. Hwang, 'Digital Logic and Microprocessor Design with VHDL', Thomson-Indian Edition, 2007.		
3. Noman Nisam& Shimon Schocken, "Elements of Computing Systems- Building a Modern computer from first principles ", MIT Press - Cambridge: London; 2005.		
References:		
1. Alan B.Marcovitz., "Introduction to Logic and Computer Design", Tata McGraw-Hill, 2009.		
2.M.Morris Mano & Charles R.Kime, "Logic and Computer Design Fundamentals", Pearson, 2014.		
3. Albert Paul Malvino& Jerald A Brown, "Digital computer Electronics", Glencoe McGraw-Hill., 1999		

Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	1	3	3	3				2	1	2	1	2	1
2	3	3	3	3	3				2	1	2	1	2	1
3	3	3	3	3	3					1		1		1
4	3		3	3	3					1		1		1
5	3		3	3	3	1	1	1	3	1	3	1	3	1

Course	**Course Title**	**L**	**T**	**P**	**C**

Code					
UEE2511	**ELECTRICAL MACHINES LAB – II**	0	0	3	1.5

Objectives:

- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

List of Experiments:

1. Predetermination of voltage regulation of three phase alternator by EMF, MMF and ZPF method
2. Determination of voltage regulation of three phase salient pole alternator by slip test
3. Determination of negative and zero sequence impedance of three phase alternator
4. Load test on three phase alternator
5. Determination of V and inverted V curves of three phase synchronous motor
6. Load test on three phase squirrel cage induction motor
7. No-load and blocked rotor test on three phase squirrel cage induction motor
8. Load test on single phase induction motor
9. No-load and blocked rotor test on single phase induction motor
10. Speed control of three phase slip ring induction motor using rotor resistance and variable frequency method
11. Separation of no-load losses of three phase induction motor

Total Periods:**45**

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

CO1: Formulate and practice the experimental procedures and measurement involved in the determination of regulation of alternators

CO2: Measure, analyze, interpret and describe the characteristics of synchronous motor.

CO3: Measure, analyze, interpret and describe the characteristics of induction motors.

CO4: Evaluate and analyze the characteristics of induction motors used in industrial applications.

References:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 2003.

2. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.

3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.

4. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2002.

5. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

6. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.

7. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition, Reprint 2015.

8. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.

9. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001.

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	1	3				1	3	1		1	2	3
2	3	3	1	3				1	3	1		1	2	3
3	3	3	1	3				1	3	1		1	2	3
4	3	3	1	3	1			1	3	1		1	2	3

Course Code	Course Title	L	T	P	C
UEE2512	**CONTROL AND INSTRUMENTATION LABORATORY**	**0**	**0**	**4**	**2**

Objectives:

- To implement a controller to a system and to study the response of the system
- To get hands on various sensors and instruments to measure basic electrical parameters.

List of Experiments:

CONTROLSYSTEMS:

1. P, PI and PID controllers (CO1)
2. Stability Analysis (CO1)
3. Modeling of Systems – Machines, Sensors and Transducers (CO2)
4. Design of Lag, Lead and Lag-Lead Compensators (CO2)
5. Position Control Systems (CO2)
6. Synchro-Transmitter- Receiver and Characteristics (CO2)
7. Simulation of Control Systems by Mathematical development tools. (CO1)

INSTRUMENTATION:

8. Bridge Networks –AC and DC Bridges (CO4)
9. Dynamics of Sensors/Transducers (CO5)
    a. Temperature transducer
    b. Pressure transducer
    c. Displacement transducer
    d. Strain gauge
    e. Flow meter
10. Power and Energy Measurement (CO2)
11. Signal Conditioning (CO3)
    a. Instrumentation Amplifier
    b. Analog – Digital and Digital –Analog converters (ADC and DACs)
12. Process Simulation (CO2)

Total Periods:**60**

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

CO1: Implement the control system concept to electrical engineering problems

CO2: Illustrate the characteristics of different converters, compensators and other instruments

CO3: Design a signal conditioning circuit and implement a bridge network and transducer concept for a particular engineering problem.

References:

1. S.Salivahanan, R.Rengaraj, and G.R.Venkatakrishnan, "Control systems Engineering", Pearson India Education, 2015.
2. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
3. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.
4. A.K. Sawhney, ‘A Course in Electrical & Electronic Measurements & Instrumentation’, DhanpatRai and Co, 2010.
5. J. B. Gupta, ‘A Course in Electronic and Electrical Measurements’, S. K. Kataria&Sons, Delhi, 2013.
6. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.
7. S. Salivahanan, R. Rengaraj, G. R. Venkatakrishnan, " Measurements and Instrumentation" McGraw Hill, 2018.

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	2		2	2	2	3					2	3	3
2	1	2		3	2								3	3
3	1	2	2	3	2		3					2	3	3

SEMESTER VI

Course Code	**Course Title**	**L**	**T**	**P**	**EL**	**C**
UEE2601	**MICROPROCESSORS AND MICROCONTROLLERS - FUNDAMENTALS AND PRACTICES**	**3**	**0**	**1**	**3**	**4.5**

Objectives:

- To impart knowledge on Architecture of 8085 & 8086 and programming in 8086
- To study the interfacing of coprocessors with 8086
- To impart knowledge on Architecture of μC 8051 and programming in μC 8051
- To impart knowledge on ARM CORTEX M3 PROCESSOR
- To study simple programming in STM32XX MICROCONTROLLER

Unit I	**MICROPROCESSOR ARCHITECTURE & INSTRUCTION SET**	**9+3**

Architecture 8085 and 8086, 8086: Addressing Modes - Instruction Set – Timing diagram – Interrupts – Programming.

Practice – Programming with 8086 – Arithmetic and logic operations – Matrix operations –

Floating point operation – Code conversions – Searching and Sorting- Data Transfer - Counter and Time Delay.

Studio –Programming 8086 using interrupts for counting and timing applications.

Unit II	**DIGITAL AND ANALOG INTERFACING WITH 8086**	**9+3**

Interfacing 8086 with: Peripheral programmable interface 8255 & Programmable interrupt timer 8253, Programmable interrupt controller 8259, Keyboard and Display Interface 8279, monitor, Direct Memory access controller 8257.Interfacing ADC and DAC.

Practice – 8253 Timer Modes - Matrix Keyboard & 7 Segment display Interfacing - Interrupt Handling with 8259, Temperature measurement, Generation of Different types of Signals with frequencies.

Studio – Speed control of DC motor using 8086 Microprocessor.

Unit III	**MICROCONTROLLERS ARCHITECTURE& INSTRUCTION SET**	**9+3**

Architecture 8051 – Pin details- Timing Diagram - Memory – Parallel Ports - Counters/Timers – Interrupts - Serial port. Addressing modes, Instruction set of 8051.
Practice - Basic Assembly Language Programming and Embedded C Programming – Arithmetic operations – Code conversions – Sorting – Look up tables – subroutines – Timer and serial port programming.

Studio - Design of a Real-Time PWM signal Generation with counter using Embedded C in 8051

Unit IV	**STM32XX - ARM CORTEX M3 PROCESSOR**	**9+3**

Cortex M3 Processor and Features – Core Peripherals – Memory Model –Bit Banding – Vector Table –NVIC Controller -Instruction set- STM32XX: General Purpose I/O (GPIO), Timer – Capture Compare unit

Practices – Programming in Embed C: GPIO, Timer - Capture & Compare Units.
Studio- Sine PWM Signal generation for 3 Phase Inverter.

Unit V	**STM32XX MICROCONTROLLER**	**9+3**

STM32XX - Watchdog –Interrupts – On chip ADC / DAC – DMA – I2C- CAN-Ethernet.
Practices: Interrupts – ADC – DMA

Studio- ADC Multi Channel Data acquisition using DMA.

	Total Periods	**60**

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

CO1: Understand the architecture and instruction set of 8085 and 8086

CO2: Interface 8086 with its coprocessors and peripheral devices.

CO3: Understand the architecture and instruction set of 8051.

CO4: Understand the architecture and instruction set of STM32.

CO5: Interface STM32 with peripheral devices.

Text Books:

1. Douglas V. Hall, 'Microprocessors and interfacing programming and hardware', Tata McGraw-Hill, 2004.
2. K Uma Rao &Andhe Pallavi, "The 8051 Microcontrollers Architecture, Programming and Applications", Pearson Publications,2nd Edition,2011.

3. PM0056 Programming manual, STM32F10xxx/20xxx/21xxx/L1xxxx - Cortex®-M3 programming manual
4. RM0008 Reference manual, STM32F101xx, STM32F102xx, STM32F103xx, STM32F105xx and STM32F107xx advanced Arm®-based 32-bit MCUs
References:
1. Kenneth J. Ayala,"The 8086 Microprocessor Programming & interfacing The PC".Penram International Publishing (India)Pvt.Ltd ,1995
2. David Calcutt, FredCowan, Hassan Parchizadesh, "8051Microcontrollers An Application Based Introduction",Elsevier Publication, 2006.
3. Donald Norris, "Programming with STM 32 getting started with the Nucleo board and C/ C++ ", McGraw-Hill Education TAB 1st edition, 2018.
4. Muhammad Ali Mazidi, SepehrNaimi"The STM32F103 ARM Microcontroller & Embedded Systems Using Assembly & C" Naimi and Mazidi Books , 2019.

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			3	3				2	2			3	3
2	3	3	3	3	3				2	2			3	3
3	3			3	3				2	2			3	3
4	3			3	3				2	2		1	3	3
5	3	3	3	3	3				2	2		1	3	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2602	**POWER SYSTEM ANALYSIS**	**3**	**0**	**0**	**3**

Objectives:

- To introduce application of numerical methods to various power system problems.
- To model the various power system components and to explain per unit quantities along with the formations of various matrices used for solving power system problems.
- To discuss various mathematical tools available for solving power flow problem.
- To discuss symmetrical and unsymmetrical fault studies in power system.
- To discuss transient stability analysis of SMIB and application of numerical methods.

Unit I	**NUMERICAL METHODS FOR POWER SYSTEMS**	**9**
Numerical solution of Non-linear equations - Gauss-Seidel and Newton Raphson iterative methods - Numerical Solution of Non-Linear Ordinary Differential Equations- Euler's method - Euler's modified method - and Runge-Kutta method		
Unit II	**MODELING OF POWER SYSTEM COMPONENTS**	**9**
Modeling of power system components – single line diagram – impedance diagram – reactance diagram – per unit quantities – change of base – bus impedance and admittance		

matrix.		
Unit III	**POWER FLOW ANALYSIS**	**9**
Bus Classifications - Load Flow Equations - Gauss-Seidel, Newton-Raphson and Fast decoupled methods of load flow analysis		
Unit IV	**FAULT STUDIES**	**9**
Symmetrical fault analysis using analysis through impedance matrix - Unsymmetrical short circuit analysis – Symmetrical components - LG, LL, LLG		
Unit V	**STABILITY STUDIES**	**9**
Steady state and transient stability of Single Machine Infinite Bus – Swing equation - Equal area criterion – Solution using Euler's modified method and Runge-Kutta method		
	Total Periods	**45**

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

CO1: Understand the basics of numerical methods to solve non-linear algebraic equations and non-linear ordinary differential equation.

CO2: Demonstrate modeling of various power system components, represent them in simple diagrams and construct computational matrices.

CO3: Apply numerical solution methods to complex and non-linear power flow problems.

CO4: Analyze symmetrical and unsymmetrical short circuit faults in a power system

CO5: Apply equal area criterion and concept of numerical solution methods to non-linear ordinary differential equation for transient stability problem.

Text Books:

1. Hadi Saadat, ‘Power System Analysis’, Tata McGraw-Hill Education, 2nd Edition, 2002.
2. John .J. Grainger & Stevenson. W.D., 'Power System Analysis', McGraw Hill, 1st Edition, 2003.
3. Prabha Kundur, “Power System Stability and Control”, McGraw Hill Education; 1st edition, 2006.

References:

1. J. Duncan Glover, M.S. Sarma& Thomas J. Overbye, “Power System Analysis and Design”, Cengage Learning, 5th Edition, 2012
2. D P Kothari, I J Nagrath ‘Modern Power System Analysis’, 3rd Edition, 2011.
3. C L Wadhwa, “Electrical Power Systems”, New Age Internationals; First Edition 2016
4. Gupta B.R., 'Power system Analysis & Design', S. Chand and Company Ltd., Re-issue Edition, 2005.
5. K. A. Gangadhar, “Electric Power Systems - Analysis, Stability & Protection”, 3rd Edition Khanna Publishers, 1998.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3		2	3			2				1		

2	3	3	1	2	3			2						
3	3	3	2	2	3			2				2	1	1
4	3	3	2	2	3			2				2	1	
5	3	3		2	3			2				2	1	

Course Code	Course Title	L	T	P	C
UEE2603	**POWER SYSTEM OPERATION AND CONTROL**	**3**	**0**	**0**	**3**

Objectives:

- To understand system load variations along with the need for voltage and frequency regulation and estimate the load using forecasting techniques.
- To understand the functions of energy control centre and provide control set-points for secure power system operation using contingency analysis.

Unit I	**INTRODUCTION**	**6**

Load characteristics, load curve - load factor - diversity factor, Importance of load forecasting - quadratic and exponential curve fitting techniques of forecasting, necessity of voltage and frequency regulation, P-f and Q-V control loops, plant level and system level controls.

Unit II	**REAL POWER-FREQUENCY CONTROL**	**12**

Basics of speed governing mechanism, speed-load characteristics, load sharing between two synchronous machines in parallel, control area concept, LFC control of a single-area system, static and dynamic analysis of uncontrolled and controlled cases, LFC control of two-area system and modelling, static analysis of uncontrolled case, tie line with frequency bias control, state variable model.

Unit III	**REACTIVE POWER-VOLTAGE CONTROL**	**9**

Generation and absorption of reactive power, Automatic Voltage Regulator (AVR): brushless AC excitation system - block diagram representation of AVR loop - static and dynamic analysis - stability compensation, voltage drop in transmission line, methods of reactive power injection - shunt and series compensation - tap changing transformer.

Unit IV	**UNIT COMMITMENT AND ECONOMIC DISPATCH**	**12**

Statement of Unit Commitment (UC) problem, constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints, UC solution methods: Priority-list method - forward dynamic programming approach, Statement of Economic Dispatch (ED) problem - input and output characteristics of thermal plant - incremental cost curve - co-ordination equations without loss and with transmission losses, ED solution by direct method and λ-iteration method, base point and participation factors method, integration of economic dispatch control with LFC.

Unit V	**COMPUTER CONTROL OF POWER SYSTEMS**	**6**

Power scenario in Indian grid, Load Dispatch Centre (LDC), functions of energy control centre, PMU and SCADA, contingency analysis for generator and line outages using linear sensitivity factors, state transition diagram.

Total Periods	**45**

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

CO1: Understand system load variations along with the need for voltage and frequency regulation and estimate the load using forecasting techniques.

CO2: Analyze the load frequency dynamics in power system and design power-frequency controller.

CO3: Articulate the various conventional methods of reactive power compensation and illustrate the model of automatic voltage regulator.

CO4: Compute the optimal dispatch of the generating units in a power system by solving Unit Commitment and economic dispatch problems.

CO5: Understand the functions of energy control centre and provide control set-points for secure power system operation using contingency analysis.

Text Books:

1.Olle. I. Elgerd, 'Electric Energy Systems theory-An introduction', Tata Mc Graw Hill Education Pvt.Ltd., NewDelhi, 34th reprint, 2010.

2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation andControl', John Wiley&Sons,Inc., 2003.

3. B. M. Weedy, B. J. Cory, N. Jenkins, J. B. Ekanayake, G. Strbac, 'Electric Power Systems', John Wiley & Sons Ltd., New Delhi, 5th edition 2013

References:

1.Nagrath. I. J. and Kothari D. P., 'Modern Power System Analysis',TataMcGraw-Hill, 14th reprint, 2009.

2.KundurP., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

Cos	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	1	1								3	2
2	3	3	3	3	3								3	2
3	3	3	3	3	2								3	2
4	3	3	3	3	2								3	2
5	3	3	3	3									3	2

Course Code	Course Title	L	T	P	C
UEE2611	POWER ELECTRONICS AND DRIVES LAB	0	0	4	2

Objectives:

- To provide hands on experience with power electronic converters and testing.

List of Experiments:

1. Characteristics of SCR and IGBT.
2. Characteristics of GTO & IGCT.
3. Single-phase AC to DC semi-converter and fully controlled converter.
4. MOSFET based step down and step-up choppers.
5. IGBT based single phase PWM inverter.
6. IGBT based three phase PWM inverter.
7. Single- phase AC Voltage controller.
8. Switched mode power converter.
9. Arduino based Gate Pulse Generation for DC-DC converter & single-phase inverter.
10. Design of gate drive circuit for power electronic converters.
11. Chopper based DC drive
12. Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC DC converters, 1Φ & 3Φ Inverters & AC voltage regulators)

Total Periods: **60**

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

CO1: Characterize the power devices through DC analysis.

CO2: Design and test AC-DC and AC-AC converters

CO3: Design and test chopper and inverter circuits

CO4: Design pulse generation circuits for power electronic converters

CO5: Evaluate the performance of power converters through simulation

References:

1. M.H. Rashid, ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, Third Edition, New Delhi, 2004.
2. P.S.Bimbra “Power Electronics” Khanna Publishers, third Edition, 2003.
3. Ashfaq Ahmed ‘Power Electronics for Technology’, Pearson Education, Indian reprint, 2003.
4. Joseph Vithayathil,’ Power Electronics, Principles and Applications’, McGraw Hill Series, 6th Edition, 2013.
5. Philip T. Krein, “Elements of Power Electronics” Oxford University Press, 2004 Edition.
6. L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
7. Ned Mohan Tore. M. Undel and, William. P. Robbins, ‘Power Electronics: Converters, Applications and Design’, John Wiley and sons, third edition, 2003.
8. S.Rama Reddy, ‘Fundamentals of Power Electronics’, Narosa Publications, 2014.
9. M.D. Singh and K.B. Khanchandani, “Power Electronics,” Mc Graw Hill India, 2013.
10. JP Agarwal,” Power Electronic Systems: Theory and Design” 1e, Pearson Education, 2002.

COs	Pos												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3				2			1	3	1				2
2	3	1	2	2	2			1	3	1		1		3
3	3	1	2	2	2			1	3	1		1	2	3
4	3	1	2	2	2			1	3	1			2	2
5	3		1	1	3			1	3	1		2	1	3

Course Code	Course Title	L	T	P	C
UEE2612	POWER SYSTEM SIMULATION LAB	0	0	3	1.5

Objectives:

The objective of this course is to understand power system voltage and frequency regulation and the functions of energy control centre and provide control set-points for secure power system operation using advanced power system simulation software's.

List of Experiments:

1.Computation of Parameters and Modelling of Transmission Lines.

2. Formation of Bus Admittance and Impedance Matrices.

3. Load Flow Analysis: Gauss-Seidel (GS), Newton Raphson (NR) and Fast Decoupled Load Flow (FDLF) method.

4. Fault Analysis.

5. Transient Stability Analysis of Single-Machine Infinite Bus System.

6. Switching surge analysis using EMTP.

7. Load –Frequency Dynamics of Single-Area and Two-Area Power Systems.

8. Economic Dispatch: Direct method, Lambda iteration method, Base point and participation factor method.

9. Unit commitment : Priority list method and Forward Dynamic programming.

10. Contingency analysis using linear sensitivity factors: Generator shift factors and line outage distribution factors.

Total Periods:**45**

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

CO1:Compute transmission line parameters and model the line for steady state analysis by formulating bus admittance matrix using inspection method and analyze the computational performance via Gauss-Seidel (GS), Newton Raphson (NR) and Fast Decoupled Load Flow (FDLF) methods of solving power flow problem.

CO2:Calculate the fault current for various types of faults in the power system and analyze the transient stability by applying different fault clearing time to the circuit breakers, also analyze the switching surge in long transmission line using EMTP, subsequently analyze the power system reliability by performing Contingency Analysis using linear sensitivity factors.

CO3:Analyze load frequency control dynamics and design appropriate controllers for single and multiple area power system and compute the optimal dispatch of the generating units in a power system by solving economic dispatch problems and determine the optimal generation schedule of the generating units in a power system by solving unit commitment problems.
References: 1. Olle. I. Elgerd, 'Electric Energy Systems theory-An introduction', Tata Mc Graw Hill Education Pvt.Ltd., NewDelhi, 34th reprint, 2010. 2. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation andControl', John Wiley&Sons,Inc., 2003. 3. B. M. Weedy, B. J. Cory, N. Jenkins, J. B. Ekanayake, G. Strbac, 'Electric Power Systems', John Wiley & Sons Ltd., New Delhi, 5th edition 2013 4. Hadi Saadat, 'Power System Analysis', Tata McGraw-Hill Education, 2nd Edition, 2002. 5. John .J. Grainger & Stevenson. W.D., 'Power System Analysis', McGraw Hill, 1st Edition, 2003. 6. Prabha Kundur, "Power System Stability and Control", McGraw Hill Education; 1st edition, 2006.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3			3								3	2
2	3	3			3								3	2
3	3	3	3	3	3								3	2

SEMESTER VII

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2701	**SOLID STATE DRIVES**	**3**	**0**	**0**	**3**

Objectives:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC motor drives.

Unit I	**DRIVE CHARACTERISTICS**	**9**
Advantages of electrical drives-Dynamics of electrical drive- Load Torques-Steady state stability- Converter motor system- Multi quadrant operation-starting and braking methods-Selection of electric drives.		
Unit II	**CONVERTER / CHOPPER FED DC MOTOR DRIVE**	**9**
Analysis of the single and three phase converter fed separately excited DC motor drive-Chopper controlled DC drive-Four quadrant operation of converter / chopper fed drives- DC		

drive for traction applications		
Unit III	**INDUCTION MOTOR DRIVES**	**9**
Stator voltage control-V/f control- Rotor Resistance Control-Slip power recovery drives-Vector control- Applications of induction motor drives for Electric vehicle.		
Unit IV	**SYNCHRONOUS MOTOR DRIVES**	**9**
Voltage source inverter and current source inverter fed synchronous motor drives- Margin angle control - Basic concepts of Sinusoidal PMAC motor drives- Brushless dc motor drives-Switched reluctance motor drives.		
Unit V	**CONTROL OF ELECTRICAL DRIVES**	**9**
Transfer function for DC motor – closed loop control with current and speed feedback– armature voltage control and field weakening control – Design of controllers; current controller and speed controller.		
	Total Periods	**45**

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

CO1: Describe the steady state operation and transient dynamics of a motor load system

CO2: Examine the operation of the converter/chopper fed DC drive

CO3: Analyse the operation and performance of induction motor drive

CO4: Describe the operation of synchronous motor drive

CO5: Outline current and speed controllers for a closed loop motor drive

CO6: Select a suitable electric drive for specific application in the industry

Text Books:

1.Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

2.R.Ramaprabha, R.Seyezhai, Solid State Drives DC and AC, SCITECH Publications,2019

References:

1.R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001

2. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.

3.ShaahinFelizadeh, “Electric Machines and Drives”, CRC Press (Taylor and Francis Group), 2013.

4. John Hindmarsh and Alasdain Renfrew, “Electrical Machines and Drives System,” Elsevier 2012.

5. Theodore Wildi, “Electrical Machines, Drives and power systems ,6th edition, Pearson Education ,2015

6. N.K. De., P.K. SEN” Electric drives” PHI, 2012.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													2
2	3	2	2											2
3	3	2	3		1								2	3
4	3	2	3		1								1	3
5	3		3	1	3								1	3

Course Code	Course Title	L	T	P	C
UEE2702	PROTECTION AND SWITCHGEAR	3	0	0	3

Objectives:

- To educate the causes of abnormal operating conditions, types of fuses, and principle of operation of circuit breakers.
- To impart knowledge on functioning of circuit breakers.
- To introduce the characteristics and functions of relays and protection schemes.
- To impart knowledge on apparatus protection.
- To introduce power system earthing

Unit I	FUSES AND PRINCIPLES OF CIRCUIT BREAKERS	9

Fuses -Fuse Characteristics, Types of Fuses, Selection of Fuses. Circuit Breakers - Difference between fuse and circuit breaker, Requirement of a circuit breakers, Difference between an isolator and circuit breaker, Basic principle of operation of a circuit breaker, Phenomena of arc, Properties of arc, Initiation and maintenance of arc, Arc interruption theories - Slepian's theory and Energy balance theory, Restriking voltage, Recovery voltage, Rate of rise of Restriking voltage, DC circuit breaking, AC circuit breaking, Current chopping, Capacitance switching, Resistance switching, Selection of breakers.

Unit II	TYPES OF CIRCUITS BREAKERS	9

Air Circuit breakers – Air break and Air blast Circuit breakers, Oil Circuit breakers - Single break, double break, minimum OCB, SF6 breaker - Preparation of SF6 gas, Puffer and non Puffer type of SF6 breakers. Vacuum circuit breakers. (Principle of operation and constructional details, Advantages and disadvantages of different types of Circuit breakers).

Unit III	PROTECTIVE RELAYS	9

Introduction, Fundamental requirements of protective relaying, Zones of Protection - Primary and Back up Protection, Classification of Relays. Electromagnetic Relays-Attracted Armature, Balanced Beam, Induction disc, Thermal Relays. Relay timing, Functional protective relay schemes - over current, directional and non-directional, distance, negative sequence, differential relays (Brief Description only).

Unit IV	APPARATUS PROTECTION	9

Alternator Protection: Stator, rotor and other miscellaneous protections -Stator inter turn fault, Earth fault and Differential protection. Transformer Protection - Protection against internal faults, Percentage Differential Protection, overheating Protection, Buchholz Relay, Protection against magnetizing inrush current, Earth fault protection, Overfluxing protection. Bus bar protection - Differential current protection. Feeder protection – Over-current, distance, pilot wire and carrier current protection.

Unit V	POWER SYSTEM EARTHING	9

Objective- tolerable limits of body current – step and touch voltage (tolerable and actual values) – Impulse behaviour of earthing systems – Neutral earthing – Arc suppression coils – grounding practice

Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Discuss the theory behind the operation of circuit breakers and select fuses for a given situation.
CO2: To analyse and compare different types of circuit breakers and select the type of circuit breaker for a given application.
CO3: To analyze the functioning of various protective relays and to explain their characteristics.
CO4: To apply proper protective schemes for power apparatus and to design the protective system for the given power system components.
CO5: Analyse various methods of power system earthing
Text Books:
1. Rao S.S. "Switchgear and Protection",13th ed. Khanna Publishers: Delhi; 2007.
2. Badri Ram, Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill, 2001.
References:
1. Soni M.L., Gupta P.V., Bhatnagar V.S., Chakrabarti A., "A Text Book on Power System Engineering", Dhanpat Rai & Co., 1998.
2. J.Nagrath, D.P.Kothari, "Power system Engineering", TMH, 1994.
3. C .L. Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", Wiley Eastern Ltd., 1993
4. Wadhwa C.L., "Electrical Power Systems", Newage International (P) Ltd., 2000.
5. Ravindranath B., and Chander N., "Power System Protection & Switchgear", Wiley Eastern Ltd., 1977.
6. Rajput R.K, "A Text book of Power System Engineering" Laxmi Publications, First Edition Reprint 2007.
7. Paithankar Y.G. and Bhide S.R., "Fundamentals of Power System Protection", Prentice Hall of India Pvt. Ltd., New Delhi–110001, 2003.
8. Oza, Nair, Mehta and Makwana, "Power System Protection and Switchgear", Tata McGraw- Hill.
9. T.S. Madhava Rao "Digital/Numerical Relays", Tata McGraw Hill 1st edition – 2005
10. V.K.Metha, Rohit Mehta, "Principles of power system", S.Chand Publications, Reprint-2006 Edition.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	1												
2	3	1	1	1		1	1	1				2	3	2
3	3	2	2		2	2	2	2				2	3	2
4	3	2	1	1		2	2	2				2	3	2
5	3					1	1	1					3	2

Course Code	Course Title	L	T	P	C
UEE2703	HIGH VOLTAGE ENGINEERING	3	0	0	3

Objectives:

- To introduce the various types of over voltages in power system and protection methods.
- To deals with the analysis of breakdown mechanisms of different types of insulating materials.
- To study the various methods for the generation and measurement of high AC, DC, impulse voltages and currents.
- To study the methods of high voltage testing techniques of electrical equipments as per standard specifications.
- To design and plan the layout of high voltage laboratory and to perform insulation coordination.

Unit I	**OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**	**9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

Unit II	**DIELECTRIC BREAKDOWN**	**9**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

Unit III	**GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS**	**9**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

Unit IV	**MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS**	**9**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers – Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

Unit V	**HIGH VOLTAGE TESTING & INSULATION COORDINATION**	**9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- design, planning and layout of high voltage laboratory - Insulation Coordination.

Total Periods	**45**

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

CO1: Ability to understand the various types of over voltages in power system and protection methods.
CO2: Ability to understand the Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
CO3: Ability to analyse the various methods for Generation of different types of over voltages
CO4: Ability to analyse the various methods for Measurement of different types of over voltages
CO5: Ability to analyse the various testing methods of power apparatus and apply the insulation coordination to the power system.
Text Books:
1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.
References:
1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, NewDelhi, Second Edition, 2013.
4. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
5. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	2	3								2	1
2	3	3	3	2	3								2	1
3	3	3	3	2	3								2	1
4	3	3	3	2									2	1
5	3	3	3	2	3								2	1

Course Code	Course Title	L	T	P	C
UEE2716	**INDUSTRIAL TRAINING / INTERNSHIP**	**0**	**0**	**0**	**2**

Students shall undergo training in R&D institutions / Academics / Industries for a minimum period of 15 days. At the end of internship students must submit a report for internal evaluation

Objectives:

- To develop skills to take up technical project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of Electrical Engineering system.
- To learn use of new tools, algorithms and techniques required to carry out any project.
- To get guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- For enabling the students to gain exposure and experience in implementing a small industry project and thus acquire the necessary confidence to carry out main project in the final year.

COURSE OUTCOMES

On Completion of the project work students will be in a position to

CO1: Formulate a real-world problem, identify the requirement and develop the design solutions.

CO2: Express the technical ideas, strategies and methodologies.

CO3: Test and validate through conformance of the developed prototype and analysis the cost effectiveness. Prepare report and present the oral demonstrations

CO4: Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	2										3	1
2				3	3					2	3		3	2
3						3	3						2	1
4								3	3	1	3	3	2	2

Course Code	Course Title	L	T	P	C
UEE2711	ADVANCED ELECTRICAL AND ELECTRONICS DESIGN LAB	0	0	4	2

Objectives:

- To provide hands on experience with high voltage testing equipment, characteristics of PV, battery, Fuel cell and interface of power electronic converter with PV source.

List of Experiments:

1. Breakdown Mechanism in Solid, Liquid and Air in Uniform/Non-Uniform Fields
2. Power Frequency Withstand Test on Transformer
3. Determination of Flashover Voltage of a 11kV Insulator
4. Simulation & Experiment on Characteristics of Solar PV Panel
5. Simulation &Experiment on Characteristics of Shadowing effect in Solar PV Array.
6. Experimental study on Solar PV System with MPPT.
7. Simulation & Experimental study on Wind Energy Generator.
8. Experimental study on Hybrid (Solar-Wind) Power System.
9. Experiment on Performance Assessment of Fuel Cell.
10. Experimental study on Charging and Discharging Characteristics of battery.
11. Simulation study on Hydel Power.

Total Periods: **60**

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

CO1: Demonstrate knowledge on the use of high voltage test equipment and the characteristics of breaking voltages in various insulators.

CO2: Illustrate the characteristics of photovoltaic modules and model suitable power electronic converters.

CO3: Experiment the wind, Wind-PV hybrid and hydel power systems and show their characteristics.

CO4: Examine the characteristics of battery and performance parameters of fuel cell.

References:

1. M.S. Naidu and V. Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill, 3rd Edition, 2004.
2. E. Kuffel and W.S. Zaengl, ‘High Voltage Engineering Fundamentals’, Pergamon press, Oxford, London, 1986.
3. D.P.Kothari, K.C Singal, Rakesh Ranjan “Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt.Ltd, New Delhi, 2013.
4. Chetan Singh Solanki, “ Solar Photovoltaics : Fundamentals, Technologies and Applications”, PHI Learning Private Limited, New Delhi, 2011
5. A.K.Mukerjee and Nivedita Thakur,” Photovoltaic Systems: Analysis and Design”, PHI Learning Private Limited, New Delhi, 2011

COs	POs												PSOs		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	3				1	3	1					
2	2	2	1	3			1	1	3	1					
3	2	2	2	3	2			1	3	1		1			
4	2	2	1	3			1	1	3	1					

Course Code	Course Title	L	T	P	C
UEE2718	**PROJECT PHASE I**	**0**	**0**	**6**	**3**

Objectives:

- To develop skills to formulate a technical project.
- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of Electrical Engineering system.
- To teach use of new tools, algorithms and techniques required to carry out the projects.
- To give guidance on the various procedures for validation of the product and analyze the cost effectiveness.
- For enabling the students to gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
- To provide guidelines to prepare technical report of the project.

COURSE OUTCOMES

On Completion of the project work students will be in a position to

CO1: Analyze literature & formulate methodology to solve complex problems by applying fundamentals of sciences and electrical engineering

CO2: Apply modern techniques and tools to arrive at feasible solutions

CO3: Function ethically and effectively as an individual, and as a member or leader in multidisciplinary teams and prepare for independent and lifelong learning.

CO4: Discuss and illustrate the effectiveness of solutions through organized technical reports and oral presentations

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	2										3	1
2				3	3					2	3		3	2
3						3	3						2	1
4								3	3	1	3	3	2	2

SEMESTER VIII

Course Code	Course Title	L	T	P	C
UEE2818	**PROJECT PHASE II**	**0**	**0**	**16**	**8**

Objectives:

- To make use of the knowledge gained by the student at various stages of the degree course.
- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students in preparing project reports and to face reviews and viva voce examination

Each student is required to submit a report on the project assigned to him by the department. The report should be based on the information available in the literature or data obtained in the laboratory/industry.

Students, in addition to the home problem will be permitted to undertake industrial/ consultancy project work, outside the department, in industries/Research labs for which proportional weightage will be given in the final assessment.

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

COURSE OUTCOMES

On Completion of the project work students will be in a position to

CO1: Analyze literature & formulate methodology to solve complex problems by applying fundamentals of sciences and electrical engineering

CO2: Illustrate the feasibility of solutions through the conduct of experiments with effective financial planning and reports with valid conclusions and recommendations.

CO3: Develop electrical engineering solutions based on societal, health, safety, legal, cultural and environmental considerations for sustainable development

CO4: Function ethically and effectively as an individual, and as a member or leader in multidisciplinary teams and prepare for independent and lifelong learning.

CO5: Discuss and illustrate the effectiveness of solutions through organized technical reports and oral presentations

CO - PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	2										3	1
2				3	3					2	3		3	2
3						3	3						2	1
4								3	3	1	3	3	2	2

HSMC – ELECTIVES –HUMANITIES I (II SEMESTER)

Course Code	Course Title	L	T	P	C
UEN2241	**LANGUAGE AND COMMUNICATION**	**2**	**0**	**2**	**3**

Objectives:

- To enhance communicative competence in general.
- To improve the ability of the students to negotiate with meaning in context.
- To develop speaking skills of the students for career needs.
- To develop sensitivity to gender, human rights, politeness and other aspects
- To enhance the skills in being persuasive in writing and speech

Unit I	**APPROACHES TO COMMUNICATION:**	**9**

The information Processing school, Shannon and Weaver; A Mathematical Theory of Communication, Formal Signal Processing approach.

Semiotic approach; information, communication and significance.

Chomskyan distinction between language structure and language use; form and function.

Towards a theory of performance; acceptability and grammaticality.

Communicative Competency; Possibility, appropriacy, feasibility.

Unit II	**MEANING IN LANGUAGE USE**	**9**

Speech Act Theory; communicative activity, elocutionary act, directives, commissives, expressive, declarations and representatives.

Grice's theory of conversational meaning; the cooperative principle, quantity maxim, quality maxim, relational maxim, manner maxim.

Ancient Indian theory of meaning; lexical, compositional, extended.

Speaker intention in communication.

Discourse meaning; context and situation.

Unit III	**STRUCTURE OF DISCOURSE/CONVERSATION:**	**9**

Coherence

Cohesion

Initiating and closing conversations

Intervention

Turn-taking

Unit IV	**POWER STRUCTURE AND LANGUAGE USE:**	**9**

Gender and language use

Politeness expressions and their use

Ethical dimensions of language use

Language rights as part of human rights

Unit V	**MEDIA AND PERSUASIVE COMMUNICATION:**	**9**

Power of media, Orwell's problem(Chomsky)

Manufacturing of opinion and hidden agendas.

Fundamentals of persuasive communication.

Persuasive quotient

Politics and communication barrier.

Total Periods	45

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: To improve their communicative competency across all skills of language.
CO2: To improve their writing ability in writing for persuasion and convincing someone.
CO3: To attend job interviews more confidently,
CO4: To improve social communication sensitive to gender and other prejudices.
CO5:To do better in the spoken component of the placement tasks
Text Books:
1. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
References:
1.Austin, 1962, J.L. How to do things with words.Oxford:ClarendonPress.Grice,P.1989.
2. Studies in the way of words. Cambridge, M.A: Harvard University Press.
3. Chomsky, N.1966. Aspects of the theory of syntax, The MITpress, Cambridge.
4. Chomsky, N.2006. Language and Mind, Cambridge University Press.
5. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
6. Gilbert, H.Harman, 1976. Psychological aspect ofthe theory of syntax in Journal of Philosophy,page75-87.
7. Stangley,J.2007.LanguageinContext. Clarendon press, Oxford.
8. Shannon, 1942. A Mathematical Theory of Communication.
9. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge University Press.

Course Outcomes	**Program Outcomes**											
	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2
CO4									2	3		2
CO5									2	3		2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEN2242	**FUNDAMENTALS OF LINGUISTICS**	**2**	**0**	**2**	**3**

Objectives:

- To introduce the students to Linguistics (the scientific study of language).
- To explore some basic issues and questions related to language such as what do we know when we know a language, the relation between language and brain, language and

society, how does a child learn a language, how the languages of the world are similar as well as different, how can we analyze language as a structure etc. • To provide students to a brief outline of language studies in Indian and western tradition and many applications of linguistics in different fields		
Unit I	**DEFINING LANGUAGE**	9
• What is language and where is language? o Language is a means of communication, a social product o Language is a cognitive ability, relation between language and brain • Study of Language in Indian and western traditions		
Unit II	**AN INSIGHT INTO LINGUISTICS**	9
• What is Linguistics and what is not Linguistics? o Linguistics is not prescriptive grammar learnt in the school o Linguistics is not learning of many languages o Linguistics provides tools to analyze language structure scientifically		
Unit III	**FORM AND FUNCTION**	9
• Levels of Language Analysis: Form and content o Sound o Word o Sentence o Meaning • Similarities and differences of languages		
Unit IV	**APPLICATIONS**	9
• Applications of Linguistics o Natural Language Processing o Clinical Linguistics o Psycholinguistics etc.		
Unit V	**IMPACT ON CAREER**	9
• Impact of linguistics on one's career o An understanding of Linguistics for better use of language o Language and personality development o Linguistic features specific to Engineers.		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: understand what is linguistics		
CO2: explore some basic issues and questions related to language		
CO3: understand the subtle difference between the use of English in Indian and western tradition.		
CO4: Familiarize themselves with the unique features of language in technology		
CO5: Understand the basics of how children acquire languages		
Text Books:		
1. Raj Kumar Sharma, 'Fundamentals of Linguistics', Atlantic Publishers, Chennai:2019.		
References:		
1. Thomas Herbst, 'English Linguistics: A coursebook for students of English', De Gruyter Mouton Publication, Germany: 2010. 2. Victoria A. Fromkin (ed.), Linguistics: An introduction to linguistic theory, Blackwell		

Publishers, USA: 2001.
3. Jeff Connor - Linto and Ralph W Fasold, 'An Introduction to Language and Linguistics', Cambridge University Press, 2014.

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2
CO4									2	3		2
CO5									2	3		2

Course Code	Course Title	L	T	P	C
UHS2243	FILM APPRECIATION	2	0	2	3

Objectives:

- To introduce students to the development of film as an art and entertainment form.
- To discuss the language of cinema as it evolved over a century.
- To enable the students to read a film and appreciate the various nuances of a film as a text.
- To guide the students to study films joyfully.

Unit 1	THE COMPONENT OF FILMS	9

- The material and equipment
- The story, screenplay and script
- The actors, crew members, and the director
- The process of film making

Unit II	EVOLUTION OF FILM LANGUAGE	9

- Film language, form, movement etc.
- Early cinema… silent film (Particularly French)
- The emergence of feature films: Birth of a Nation Talkies
- Films and their influence on the language of people

Unit III	FILM APPRECIATION	9

- Realist theory; Auteurists
- Psychoanalytic, Ideological, Feminists
- How to read films?
- Film Criticism / Appreciation

Unit IV	DEVELOPMENT OF FILMS	9

- Representative Soviet films
- Representative Japanese films
- Representative Italian films
- Representative Hollywood film and the studio system

Unit V	INDIAN FILMS	9

- The early era
- The important films made by the directors E-3: The regional films
- The documentaries in India
- The Indian Film Industry and the Hollywood
- The impact of Films on students in India.

Total Periods	45

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

CO1: the process of the development of film as an art and entertainment form.

CO2: the evolution of the language of cinema as it evolved over a century.

CO3: the script writing techniques of a film and appreciate the various nuances

CO4: the evolution of film industry from the past to present

CO5: how to appreciate all aspects of the film.

Text Books:

1. Jim Piper, 'The Film Appreciation Book': The Film Course You Always Wanted to Take, Allworth Press, New York: 2014.

References:

1. Stanley Cavell, 'The World Viewed: Reflections on the Ontology of Film, Enlarged Edition', Harvard University Press, 1979.
2. Joseph M. Boggs, Dennis W. Petrie, 'The Art of Watching Films', McGraw – Hill, 2006.
3. Bernard F. Dick, 'Anatomy of Film', St. Martins Press, 1990.
4. Understanding the Film: An Introduction to Film Appreciation by Jan Bone and Ron Johnson

COs	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2
CO4									2	3		2
CO5									2	3		2

Course Code	Course Title	L	T	P	C
UHS2241	**HUMAN RELATIONS AT WORK**	**2**	**0**	**2**	**3**

Objectives: The objectives of this course are to make students:

- aware of human relations at work its relationship with self.
- aware about the processes involved in interaction with people at work.
- understand the importance of psychological and physical health in maintaining human relations at work and progressing in career.
- Understand the ways and means to improve human relations at work.
- Realize the importance of safeguarding themselves from any exploitation.

Unit I	**HUMAN RELATIONS**	**9**

- Understanding and Managing Yourself
- Human Relations and You
- Self-Esteem and Self Confidence
- Self-Motivation and Goal Setting
- Emotional Intelligence
- Attitudes and Happiness
- Values and Ethics and Problem Solving and Creativity.

Unit II	**INTERPERSONAL RELATIONSHIP**	9

- Dealing Effectively with People
- Communication in the Workplace
- Specialized Tactics for Getting Along with Others in the Workplace
- Managing Conflict; Becoming an Effective Leader
- Motivating Others and Developing Teamwork
- Diversity and Cross-Cultural Competence

Unit III	**HEALTHY LIVING**	9

- Staying Physically Healthy
- Yoga, Pranayam
- Exercise: Aerobic and anaerobic

Unit IV	**MENTAL WELL BEING**	9

- Staying Psychologically Healthy
- Managing Stress and Personal Problems
- Meditation

Unit V	**CAREER READINESS**	9

- Developing Career Thrust
- Getting Ahead in Your Career
- Learning Strategies
- Perception
- Life Span Changes
- Developing Good Work Habits

Total Periods	45

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

CO1: will enhance their awareness about human relations at work and its relationship with

self
CO2: become aware of the processes involved in interaction with people at work
CO3: understand the importance of psychological and physical health in maintaining human relations at work.
CO4: will be able to understand the ways and means to improve human relations at work.
CO5: will realize the importance of safeguarding themselves from any exploitation.
Text Books:
1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts,Applications,andSkills,11thEd.UpperSaddleRiver,NJ:Pearson.
References:
1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition). New York: McGraw Hill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

COs	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						2		2	3	2		2
CO2						2		2	3	2		2
CO3						2		2	3	2		2
CO4						2		2	3	2		2
CO5						2		2	3	2		2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UHS2242	**APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE**	**2**	**0**	**2**	**3**

Objectives:

The objectives of this course are to make students:

- aware of the different applications of psychology to everyday issues of life,
- aware of the different social issues, workplace issues, and behavioural issues, and
- understand how the knowledge gained from this course can be used in their own personal and professional work life.
- Understand the psychological principles relevant to human development.
- Understand the impact of Psychology on human life

Unit I	**PSYCHOLOGY OF AN INDIVIDUAL**	**9**

- Introduction: Nature and fields.
- The individual human being and his or her experiences, mental processes and behaviors.

Unit II	**DIFFERENT TYPES OF PSYCHOLOGY**	9

- Psychology in industries and organizations: Job analysis; fatigue and accidents; consumer behavior.
- Different types of psychology: cognitive, forensic, social, and developmental psychology

Unit III	**PSYCHOLOGY AND MENTAL HEALTH**	9

Psychology and mental health: Abnormality, symptoms and causes psychological disorders. Psychology for better decision making, stress management and behavior.

Unit IV	**COUNSELING**	9

Psychology and Counseling: Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

Unit V	**SOCIAL BEHAVIOR**	9

Psychology and social behavior: Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation

Total Periods	45

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

CO1: raise their awareness on applications of psychology to everyday issues of life

CO2: deal more efficiently with different issues in society, workplace and human behavior.

CO3: Apply principles of psychology in their own personal and professional lives.

CO4: Use the psychological principles for their own human development.

CO5: Appreciate the impact of Psychology on human life

Text Books:

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall.

References:

1. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
2. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
3. Aronson, E., Wilson, T. D., &Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall.

Cos	**Program Outcomes**											
	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						2		2	3	2		2
CO2						2		2	3	2		2
CO3						2		2	3	2		2
CO4						2		2	3	2		2
CO5						2		2	3	2		2

Course Code	Course Title	L	T	P	C
UEN2243	UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE	2	0	2	3

Objectives:

- To acquire skills not only the ones necessary for one's "trade", but also the ones to acquire knowledge and become a better human being, as a means towards the end of creating a better society.
- To facilitate understanding a society, its people, their mind, prevalent traditions and culture with a view to developing a holistic worldview, which is essential for a sustainable society.
- To introduce students to literary works of various countries/ regions / societies and attempt to understand the respective traditions to which the works belong.
- To understand the relationship between life and literature

Unit I	LITERATURE AND LIFE	9

- Traditional Knowledge.
  - what is Literature?
  - Significance of studying literature,
  - Studying society and culture through literature,
  - Understanding morality through literature.
  - Reading of Literary texts –The literary piece will be given to students beforehand so that they read it and become familiar with the texts before coming to the class. In the class, the text will be read once again, where doubts if any will be cleared.
  - First Discussion – The reading will be followed by a discussion where the text will be analyzed in detail. The students will be encouraged to share their interpretation of the text.

Unit II	RESOLVING DILEMMA	9

- Definition and Description of 'Dilemma'
- Choice of literary texts to confront situations where one is faced with a dilemma (differentiating what is right and wrong? and develop a deeper insight into the various realities of life.
- Presentation of analysis of the literary text (The students will keep in mind the author's background and the socio-historical and cultural backgrounds while preparing this presentation)
- Q&A Session on the Presentation (the students will be encouraged to ask questions to their respective classmates regarding the presentation/analysis initiating a second discussion on the text.

Unit III	GENDER STUDIES	9

- Literary pieces that question the current notions of gender, and raises uncomfortable questions,
- Literature that challenges the status quo, forcing us to think about the real meaning of equality and emancipation

• Second Discussion– (Having made their presentation, and heard the presentations made by their classmates, the students would now have a fairly good idea of the various nuances of the text, making it a ripe moment to have the second detailed discussion on the text. Here the teacher may refer to those points which may have been missed by the student		
Unit IV	**READING LITERATURE**	9
• Reading of select Literary works • The author's Background, Historical and Social Background for a better understanding of the literary work • Study of other significant study material as required for an overall understanding of the literary work.		
Unit V	**READINGS**	9
Submission of a report–Having faced questions from their classmates, and after having a second discussion on the text, the student would come across new ideas which will be incorporated into the analysis and submitted in the form of a report.		
	Total Periods	45
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Improve their awareness of various traditions.		
CO2: Not only understand the diversity found between various traditions but also celebrate them.		
CO3: Strengthen their analytical capability.		
CO4: Improve their language skills and ability of expressing complex ideas.		
CO5: understand the relationship between life and literature		
Text Books:		
1. Literary works will be provided by the teacher. Author's Background,		
2. Historical and Social Background which are significant for a better understanding of the work will be provided by the teacher.		
Reference:		
Reference materials or other significant study materials as required for an overall understanding of the literary work will be sourced out by the students in consultation with the teacher		

Course Outcomes	**Program Outcomes**											
	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1									2	3		2
CO2									2	3		2
CO3									2	3		2
CO4									2	3		2
CO5									2	3		2

MANAGEMENT ELECTIVES (V SEMESTER)

Course Code	Course Title	L	T	P	C
UBA2541	**PRINCIPLES OF MANAGEMENT**	**3**	**0**	**0**	**3**

Objectives:

To impart knowledge about the following topics:

- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business

Unit I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**9**

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management.

Unit II	**PLANNING**	**9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit III	**ORGANISING**	**9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

Unit IV	**DIRECTING**	**9**

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT.

Unit V	**CONTROLLING**	**9**

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

Total Periods	**45**

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

CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO2: Have same basic knowledge on international aspect of management.

CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.
Text Books:
1. Harold Koontz and Heinz Weihrich “Essentials of Management”, Tata McGraw Hill, 1998.
2. Stephen P. Robbins and Mary Coulter, “Management”, Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.
References:
1. Robert Kreitner and Mamata Mohapatra, “Management”, Biztantra, 2008. 2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, “Fundamentals of Management”, Pearson Education, 7th Edition, 2011. 3. Tripathy PC and Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

Course Outcomes	**Program Outcomes**											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1											2	1
CO2									2		3	1
CO3									2		2	1
CO4					3					2	2	1
CO5											1	1

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UBA2542	**TOTAL QUALITY MANAGEMENT**	**3**	**0**	**0**	**3**

Objectives:

To impart knowledge about the following topics:

- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

Unit I	**INTRODUCTION**	**9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction)-- TQM Framework- Barriers to TQM –Benefits of TQM.

Unit II	TQM PRINCIPLES	9
Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.		
Unit III	**TQM TOOLS & TECHNIQUES I**	**9**
The seven traditional tools of quality - New management tools - Six-sigma Process Capability Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.		
Unit IV	**TQM TOOLS & TECHNIQUES II**	**9**
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM –Concepts, improvement needs – Performance measures- Cost of Quality - BPR.		
Unit V	**QUALITY MANAGEMENT SYSTEM**	**9**
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards -AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-InternalAudits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.		
	Total Periods	**45**

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

CO1: Ability to apply TQM concepts in a selected enterprise.

CO2: Ability to apply TQM principles in a selected enterprise.

CO3: Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.

CO4: Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Ability to apply QMS and EMS in any organization.

Text Books:

Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

References:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth –Heinemann Ltd, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition,2003.
4. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12
CO1						3		2	1		1	1
CO2						3			2		1	1
CO3					2	3			1		1	1
CO4						3	1		1		1	1
CO5						3	2		1		1	1

Course Code	Course Title	L	T	P	C
UBA2543	WORK ETHICS, CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE	3	0	0	3

Objectives:

To impart knowledge about the following topics:

- To impart the value of professional practices with code of conduct and ethical values
- Discuss the various outlooks of roles and responsibilities with work ethics.
- Introduce the Indian constitutional statutes for ethical practices by citizens
- Analyze the ethical commitments to be hold by industry with protecting environment
- Insist on corporate and social responsibilities through Governance practices and regulation

Unit I	**INTRODUCTION**	**9**

Ethics - Definition & nature, Characteristics, Attributes of Ethics - Business Ethics; Ethical theories; Causes of unethical behavior; Ethical abuses; Work ethics; Code of conduct; Public good.

Unit II	**ETHICS THEORY AND BEYOND**	**9**

Management of Ethics - Ethics analysis [Hosmer model]; Ethical dilemma; Ethics in practice – ethics for managers; Role and function of ethical managers- Comparative ethical behaviour of managers; Code of ethics; Competitiveness, organizational size, profitability and ethics; Cost of ethics in Corporate ethics evaluation.

Unit III	**LEGAL ASPECTS OF ETHICS**	**9**

Political – legal environment; Provisions of the Indian constitution pertaining to Business; Political setup – major characteristics and their implications for business; Prominent features of MRTP &FERA. Social – cultural environment and their impact on business operations, Salient features of Indian culture and values.

Unit IV	**ENVIRONMENTAL ETHICS**	**9**

Economic Environment; Philosophy of economic grow and its implications for business, Main features of Economic Planning with respect to business; Industrial policy and framework of government contract over Business; Role of chamber of commerce and confederation of Indian Industries.

Unit V	**CORPORATE SOCIAL RESPONSIBILITY AND GOVERNANCE**	**9**

Definition- Evolution- Need for CSR; Theoretical perspectives; Corporate citizenship; Business practices; Strategies for CSR; Challenges and implementation; Evolution of corporate governance; Governance practices and regulation; Structure and development of boards; Role of capital market and government; Governance ratings; Future of governance-innovative practices; Case studies with lessons learnt.

Total Periods | **45**

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

CO1: Understand ethical issues in workplace and have good practices in professional duties.

CO2: Learn roles and responsibilities in professional career as a team worker

CO3: Understand the legal aspects in Indian constitutional for protection of societal values

CO4: Analyze the economical development by industry with importance to environment protection.

CO5: Understand need of good Governance in a corporate with ethical organizational behavior.

Text Books:

1. S.A. Sherlekar, Ethics in Management, Himalaya Publishing House, 2009.
2. William B. Werther and David B. Chandler, Strategic corporate social responsibility, SagePublications Inc., 2011
3. VVRobert A.G. Monks and Nell Minow, Corporate governance, John Wiley and Sons, 2011.

References:

1. VW.H. Shaw, Business Ethics, Cengage Learning, 2007.
2. Beeslory, Michel and Evens, Corporate Social Responsibility, Taylor and Francis, 1978.
3. Philip Kotler and Nancy Lee, Corporate social responsibility: doing the most good for company and your cause, Wiley, 2005.
4. Subhabrata Bobby Banerjee, Corporate social responsibility: the good, the bad and the ugly, Edward Elgar Publishing, 2007.
5. Satheesh kumar, corporate governance, Oxford University, Press, 2010.
6. Bob Tricker, Corporate governance- Principles, policies and practices, Oxford University Press, 2009
7. Larue Tone Hosmer and Richard D., The Ethics of Management, Irwin Inc., 1995.
8. Joseph A. Petrick and John F. Quinn, Management Ethics - integrity at work, Sage, 1997.

Course Outcomes	Program Outcomes											
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1								3	1	1		2
CO2								3	1	1		2
CO3						3	2	3	1	1		2
CO4							2	3	1	1	3	2
CO5								3	1	1	2	2

PROFESSIONAL ELECTIVE I (SEMESTER – V)

Course Code	Course Title	L	T	P	C
UEE2521	SOLAR ENERGY SYSTEMS	3	0	0	3

Objectives:

- To study about solar cells and photovoltaic system design for standalone and grid connected applications
- To understand different applications of photovoltaic system.

Unit I	**INTRODUCTION**	**9**

Characteristics of sunlight – semiconductors and P-N junctions –behaviour of solar cells – cell properties and design – PV Cell interconnection and module fabrication.

Unit II	**STAND ALONE PHOTOVOLTAIC SYSTEM**	**9**

Standalone PV system design - Solar modules – storage systems – power conditioning and regulation - Balance of system components – Designing standalone PV systems – sizing.

Unit III	**GRID CONNECTED PHOTOVOLTAIC SYSTEMS**	**9**

PV systems in buildings – utility applications for photovoltaics - design issues for central power stations – safety – Economic aspect –standards and guidelines for PV systems, Efficiency and performance - International PV programs.

Unit IV	**PHOTOVOLTAIC WATER PUMPING SYSTEM COMPONENTS**	**9**

System configuration - Water Pumps - Motors - Power conditioning circuitry - Batteries - Array wiring and mounting - PV water pumping system design -Example of a directly coupled system design.

Unit V	**SOLAR APPLICATIONS**	**9**

Space - Marine - Telecommunications - Photovoltaic powered transport - Solar Cars - Solar Furnaces - Solar Refrigeration.

Total Periods	**45**

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

CO1: Explain the characteristics, techniques of solar energy conversion system and PV module fabrication

CO2: Design a standalone photovoltaic system

CO3: Describe a grid connected photovoltaic system and identify the challenges

CO4: Design a PV water pumping system

CO5: Discuss the applications of solar energy

Text Books:

1. Stuart R.Wenham, Martin A.Green, Muriel E. Watt, Richard Corkish and Alistair Sproul, "Applied Photovoltaics", Third Edition, 2011,Earthscan, UK.

2. Solanki C.S., “Solar Photovoltaics: Fundamentals, Technologies And Applications”, PHI Learning Pvt. Ltd., 2015.

References:

1. Eduardo Lorenzo G. Araujo, Solar electricity engineering of photovoltaic systems,

Progensa,1994.
2. Solar & Wind Energy Technologies – McNeils, Frenkel, Desai, Wiley Eastern, 1990
3. S.P. Sukhatme , “Solar Energy”, Tata McGraw Hill,1987.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3												1	2
2	3	3	2	3	2				2	1		1	1	2
3	3	3	2	3	2				2	1		1	2	3
4	3	3	2	3	2		2		2	1		1	2	2
5	3	3	2	3	2		2		2	1		1	1	3

Course Code	Course Title	L	T	P	C
UEE2522	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	3	0	0	3

OBJECTIVES

- To learn the fundamentals of Discrete Fourier transform and its properties
- To understand the design aspects of frequency selective digital filters
- To interpret the implementation issues in designing digital filters
- To understand the concepts of Liner predictive coding and adaptive filters

Unit I	DISCRETE-TIME RANDOM SIGNALS	10

Discrete Fourier Transforms: Review of main concepts form Signals and Systems course- Frequency domain sampling and reconstruction of discrete time signals - The DFT as a Linear Transformation - Relationship of the DFT to other Transforms - Properties of DFT - Linear Filtering methods based on DFT - Efficient computation of the DFT-FFT Algorithms. Filtering long data sequences - overlap save and overlap add method. Efficient computation of DFT of Two real sequences - efficient computation of the DFT of a 2N- Point Real sequences - Use of FFT in Linear filtering and correlation.

Unit II	DESIGN OF FIR FILTERS	8

Ideal filter characteristics, causality and its implications, characteristics of practical frequency selective filters. Design of FIR filters - Symmetric FIR filters, design of linear-phase FIR filters using windows: rectangular window, Hamming window. Frequency sampling method.FIR filters for harmonic elimination.

Unit III	DESIGN OF IIR FILTERS	8

Design from Analog filters. Design of digital IIR low-pass filter from analog filters - Impulse Invariance and Bilinear Transformation. Frequency transformations for analog and digital filters.

Unit IV	DIGITAL FILTER REALIZATION	8

Structures for the realization of Discrete time system - Structures for FIR systems - direct

form structures, cascade form structures, frequency sampling structures. Structures for IIR systems - Direct form structures, Cascade form structures, Parallel form structures and Analysis of Finite Word Length Effect and limit cycle oscillations in recursive systems.		
Unit V	**APPLICATIONS OF DSP IN ELECTRICAL ENGINEERING**	**11**
Multi-rate processing, Sampling rate conversion, Decimation and interpolation, Introduction to QMFs.Linear predictive coding, forward linear prediction, Levinson-Durbin algorithm, signal synthesis, Application in power systems. Basics of adaptive filters, FIR Adaptive filters, Adaptive filters based on steepest descent method, the LMS algorithm, Application in control systems.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Apply discrete Fourier transform for the analysis of digital signals and systems		
CO2: Design and realize FIR filters		
CO3: Design and realize a frequency selective digital IIR filters		
CO4: Realize different structures of digital filters		
CO5: Apply the concepts filtering in electrical engineering		
Text Books:		
1. Sanjit K. Mitra, "Digital Signal Processing, A Practical approach", Tata McGraw Hill Publishing Company Limited, 2005		
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth,2007.		
References:		
1. Alan V. Oppenheim, Ronald W. Schaffer and John R. Buck, Discrete time signal processing, Prentice Hall, Third Edition, 2009. 2. Vinay K. Ingle and John G. Proakis, Digital Signal Processing using MATLAB, Cengage learning, Third Edition, 2011. 3. Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning, First Edition, 2006.		

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3		1									
2	1	2	3	2									3	
3	1	2	3	2									3	
4	1	1	3	1										
5									2			2	3	3

Course Code	Course Title	L	T	P	C
UEE2523	ENERGY RESOURCES AND UTILIZATION	3	0	0	3

Objectives:

- To introduce energy scenario and to discuss various commercial energy available in India
- To introduce renewable energy source like Solar and Wind
- To discuss utilization of electrical energy based on domestic consumers.
- To discuss utilization of electrical energy with respect to refrigeration and air conditioning
- To explain industrial utilization and traction of electrical energy

Unit I	**COMMERCIAL ENERGY**	**9**

Coal, Oil, Natural gas, Nuclear power and Hydro - their utilization pattern in the past, present and future projections of consumption pattern - Sector-wise energy consumption – environmental impact of fossil fuels – Energy scenario in India – Growth of energy sector and its planning in India.

Unit II	**RENEWABLE ENERGY**	**9**

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation -principle of photovoltaic conversion of solar energy, types of solar cells – Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics

Unit III	**DOMESTIC UTILIZATION AND ILLUMINATION**	**9**

Online and OFF line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing – Importance of lighting –laws of illumination –types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting – LED lighting and energy efficient lamps.

Unit IV	**REFRIGERATION AND AIR CONDITIONING**	**9**

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

Unit V	**INDUSTRIAL UTILIZATION AND TRACTION**	**9**

Role of electric heating for industrial applications – resistance heating – induction heating – dielectric heating. Brief introduction to electric welding – welding generator, welding transformer and the characteristics.Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

Total Periods	**45**

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

CO1: Discuss the basics of commercial energy and their utilization pattern and future projections of consumption pattern with respect to Indian scenario.

CO2: Demonstrate the renewable energy resources like solar and wind and their electrical conversion.
CO3: Explain the domestic utilization of electricity in particular to UPS, and power quality issues along with illumination techniques and LED lightning.
CO4: Explain the refrigeration and air conditioning system, along with energy efficient motors and their saving in energy utilization.
CO5: Explain the industrial utilization of electricity in particular toheating, welding and electric traction.
Text Books:
1. Wadhwa, C.L. "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd, 2003.
2.Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3. Bent Sorensen , “Renewable Energy”, Elsevier, Academic Press, 2011.
4. Kishore V.V.N., “Renewable Energy Engineering and Technology”, Teri Press, New Delhi,2012
References:
1. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.
2. Openshaw Taylor.E, "Utilization of Electrical Energy in SI Units", Orient Longman Pvt. Ltd, 2003.
3.Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.
4.Sukhatme S.P., “Solar Energy”, Tata McGraw Hill, 1984.
5.Twidell J.W. and Weir A., “Renewable Energy Sources”, EFN Spon Ltd., 1986.
6.Veziroglu T.N., Alternative Energy Sources”, Vol 5 and 6, McGraw-Hill, 1990.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3						2				1		
2	3	3	1					2					2	1
3	3	3	1	1				2				2	1	2
4	3	3	1	1				2				2		
5	3	3						2				2	1	1

Course Code	Course Title	L	T	P	C
UEE2524	COMMUNICATION ENGINEERING	3	0	0	3

Objectives:

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To study the principles behind information theory and coding
- To understand the concept of spread spectrum system

Unit I	ANALOG MODULATION	9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – modulators and demodulators – Angle modulation – PM and FM, modulators and demodulators – Super heterodyne receivers, Comparison of AM, FM and PM

Unit II	PULSE MODULATION	9

Low pass sampling theorem – Quantization – Pulse Amplitude Modulation (PAM) – Line coding – Pulse Code Modulation (PCM), DPCM, Delta Modulation (DM), and ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing.

Unit III	DIGITAL MODULATION AND TRANSMISSION	9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-arysignaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers.

Unit IV	INFORMATION THEORY AND CODING	9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding.

Unit V	SPREAD SPECTRUM AND MULTIPLE ACCESS	9

PN sequences – properties – m-sequence – Direct Sequence Spread Spectrum (DSSS) – Processing gain, Jamming – Frequency Hoping Spread Spectrum (FHSS) – Synchronization and tracking – Multiple Access – FDMA, TDMA, CDMA, Application of wireless communication – GSM

	Total Periods	45

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

CO1:Explain the basic analog modulation techniques

CO2:Explain the basic digital modulation and transmission techniques.

CO3:Explain the various pulse modulation and line coding techniques.

CO4:Show and analyze, how encoding and decoding technique is processed using simple maths

CO5: Explain the various spread spectrum and multiple access techniques.

Text Books:

1. H Taub, D L Schilling, G Saha, “Principles of Communication Systems” 3/e, TMH 2007

2. S. Haykin “Digital Communications” John Wiley 2005.

References:
1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007.
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006.
3.B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1	1			2				1			1	2	1
2	1	1			2				1			1		1
3	1	1			2				1			1		1
4	3	1			2				1			1		1
5	1	1			2				1			1		1

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2525	**LOW VOLTAGE DIRECT CURRENT SYSTEMS**	3	0	0	3

Objectives:

- To introduce the students to LVDC
- To explore some basic issues and questions related standards
- To provide students to a brief DC Power System Architecture and microgrid

Unit I	**INTRODUCTION TO LVDC**	**9**

Introduction to LVDC (Low Voltage Direct Current) Microgrid for Commercial Buildings DC Microgrid Characteristics, Safety and protection, Reliability, Integration. DC Microgrid Design Methodology, DC Converters, DC Microgrid Applications, DC Microgrid for Commercial Building, Monitoring System for Microgrid

Unit II	**COMMUNICATIONS STANDARDS**	**9**

Communications standards DC Loads, Present DC Loads DC Loads for the Future Energy Source for DC Microgrid, PV Solar Cell, Fuel Cell, Types of PV Solar Conversion Energy Storage for DC Microgrid Battery, Super capacitor

Unit III	**DC POWER SYSTEM ARCHITECTURE**	**9**

Power System Architecture, Utility Grid Energy Storage System, PV Solar Panel integrated system

Unit IV	**DC MICROGRID**	**9**

Loads in DC Microgrid, Power Array Conversion for DC Microgrid, Array Conversion Architecture, Array Conversion Mathematical Model

Unit V	**SWITCHING FUNCTION**	**9**

Switching Function for Array Conversion, Simulation Setup Configuration of the Simulation System, DC Microgrid Components for Simulation	
Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to	
CO1: Explain microgrid design methodology and applications	
CO2: Analyse PV solar cell, fuel cell and energy storage types for DC micro grid.	
CO3: Explain DC power system architecture	
CO4: Realise Efficient Low Voltage DC Microgrid with Power Array Conversion	
CO5: Illustrate the switching function for array conversion and DC Microgrid Components	
Text Books:	
1. LVDC: Electricity for the 21st century, IEC Technology Report	
2. An Efficient Low Voltage DC Microgrid with Power Array Conversion for Commercial Buildings, Ph D Thesis, Zhiqing Wu, Florida Institute of Technology, 2019	
3. Bimal k Bose, "Modern power electronics : evolution, technology, and applications", Newyork Publishers, IEEE press,1991.	
4. Ahmed F Zobaa, "Energy Storage: Technologies and Applications", 23 January 2013, Intechopen Publisher, ISBN-13 : 978-9535109518	
5. Fang Lin Luo, Hong Ye, "Advanced Multi-Quadrant Operation DC/DC Converters", CRC Press, First edition, 2005, ISBN-13 : 978-0849372391.	
References:	
1. Jens Bo Holm-Nielsen and Padmanaban Sanjeevikumar, "Power Electronic Converter Configuration and Control for DC Microgrid Systems", MDPI publishers, ISBN 978-3-03936-431-2 (Hbk); ISBN 978-3-03936-432-9, July 2020 edition. https://doi.org/10.3390/books978-3-03936-432-9	
2. El-Shahat A, Sumaiya S. "DC-microgrid system design, control, and analysis", Electronics. MDPI Publishers, 2019 Feb;8(2):124.	

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	1		1	1	1									2
2	3		2	2	2								1	3
3	3		2	2	2								2	3
4	3		2	2	2								1	2
5	3		2	2	2									2

PROFESSIONAL ELECTIVE II (SEMESTER -VI)

Course Code	Course Title	L	T	P	C
UEE2621	WIND ENERGY CONVERSION SYSTEMS	3	0	0	3

Objectives:

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed wind energy conversion systems.
- To analyze the grid integration issues.

Unit I	**INTRODUCTION**	**9**
Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory - Power coefficient- Sabinin'stheory-Aerodynamics of Wind turbine.		
Unit II	**WIND TURBINES**	**9**
HAWT-VAWT-Power developed -Thrust-Efficiency-Rotor Selection-Rotor design considerations Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control stall control-Schemes for maximum power extraction.		
Unit III	**FIXED SPEED SYSTEMS**	**9**
Generating Systems- Constant speed constant frequency systems -Choice of Generators - Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.		
Unit IV	**VARIABLE SPEED SYSTEMS**	**9**
Need of variable speed systems-Power-wind speed characteristics - Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modelling - Variable speed variable frequency schemes.		
Unit V	**GRID CONNECTED SYSTEMS**	**9**
Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modelling issue.		
	Total Periods	**45**

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

CO1:Acquire knowledge on the basic concepts of wind energy conversion system

CO2: Demonstrate the types of wind turbine and aero dynamics

CO3: Explain the principle of fixed speed system.

CO4: Illustrate the working and design of variable speed system.

CO5: Analyze the grid integration issues and current practices of wind interconnection.

Text Books:

1.L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990

2.S.N.Bhadra, D.Kastha, S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010.

References:
1. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
2.E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd.,Trowbridge,1976
3. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
4.S.Heir “Grid Integration of WECS”, Wiley 1998.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2												1	2
2	3	2	1											2
3	3	2	2	3								2		2
4	3	2	2	3								2	2	3
5	3	2	2	3	3				2	1		2	2	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2622	**ADVANCED CONTROL THEORY**	**3**	**0**	**0**	**3**

Objectives:

- To give exposure to linear vector spaces.
- To impart knowledge and skills needed to design state feedback controller and state observer fir Time-Invariant Linear system (Continuous time)
- To introduce concepts needed to understand and analyseliner and nonlinear systems.
- To give exposure to design of nonlinear controller
- To provide the ability to apply advanced control strategies to practical engineering Problems

Unit I	**FUNDAMENTAL MATHEMATICS FOR STATE SPACE ANALYSIS**	**9**

Linear vector spaces – Basis –Span –Subspaces-Rank Nullity dimension theorem- Similarity transformations- Inner product –Matrix norms - Cayley Hamilton theorem - Quadratic functions and Definiteness of matrices - Projection theorem- Gram Smith ortho-normalization procedure – Grammian matrix – Factorization – Eigen decomposition- Jordon form -Singular value decomposition.

Unit II	**STATE VARIABLE ANALYSIS**	**9**

Introduction- Concepts of state space – non uniqueness of state model –Evaluation of matrix exponents - Solution of state equations- Decomposition – Controllable, Observable & canonical from- Controllability & Observability - Duality (LTI).

Unit III	**STATE CONTROLLER DESIGN**	**9**

Controllability and Observability Grammians, Open loop minimum energy control, State

feedback - Pole placement – Design of State regulator & state observer- Separation principle- Design of servo systems: State feedback with integral control.		
Unit IV	**NON LINEAR SYSTEMS**	**9**
Common physical nonlinearities, Phase plane method: concepts, Singular points, phase plane trajectories- Stability analysis by describing function method, Jump resonance.		
Unit V	**NON LINEAR CONTROL**	**9**
Lyapunov's stability theory - Jacobian linearization and gain scheduling - Feedback linearization: Input-output linearization, full-state linearization, stabilization, Sliding Mode Control.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Ability to remember and apply linear vector space concepts.		
CO2: Ability to design and analyse state feedback controller and state observer.		
CO3: Ability to understand and analyse linear and nonlinear systems using phase plane method and analyse nonlinear systems using describing function method.		
CO4: Ability to understand and design a nonlinear control		
CO5: Ability to apply advanced control strategies to practical engineering problems.		
Text Books:		
1.M.Gopal, "Digital Control and State Variable Methods", 4th edition, McGraw Hill India, 2012		
2.K.P.Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.		
References:		
1.M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014.		
2.GlibertStang, Introduction to Linear Algebra – 5th Edition, Wellesley - Cambridge Press, 2016		
3. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.		
4. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.		

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			1									3	
2		2			2								3	2
3		3			2								3	2
4		3	2		2								3	2
5				3	2								3	

Course Code	Course Title	L	T	P	C
UEE2623	POWER SYSTEM DYNAMICS	3	0	0	3

Objectives:

- To understand the basics of system dynamics in power system.
- To understand the modeling of synchronous machine.
- To understand excitation systems and speed governing controllers.
- To analyze the transient stability of multi machine power system.
- To understand the dynamic stability of power system.

Unit I	**INTRODUCTION**	**9**

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design – distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

Unit II	**SYNCHRONOUS MACHINE MODELLING**	**9**

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

Unit III	**MACHINE CONTROLLERS**	**9**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

Unit IV	**TRANSIENT STABILITY**	**9**

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

Unit V	**DYNAMIC STABILITY**	**9**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact – linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals – dynamic performance measure - small signal performance measures

Total Periods	**45**

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

CO1: Ability to study the basics of dynamics and stability problems.

CO2: Ability to understand modeling of synchronous machines.

CO3: Ability to analyse the need and study the operation of the excitation system and speed-governing controllers.
CO4: Ability to analyse the transient stability simulation of multi machine power system.
CO5: Ability to model and analyse the dynamic stability of synchronous machine in power system.
Text Books:
1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.
References:
1.M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2.James A.Momoh, Mohamed. E. EI-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	3									
2	3	3	3	3	3									
3	3	3	3	3	3									
4	3	3	3	3	3								1	
5	3	3	3	3	3								1	

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2624	**VLSI DESIGN TECHNIQUES**	**3**	**0**	**0**	**3**

Objectives:

- To learn the fundamentals of CMOS circuits and its characteristics.
- To understand the combinational and sequential circuit design
- To gain knowledge about design choices of arithmetic circuits and FPGA architectures
- To learn the programming constructs of VHDL

Unit I	**MOS TRANSISTOR THEORY**	**9**

NMOS and PMOS transistors, CMOS logic, MOS transistor theory – Introduction, Enhancement mode transistor action, Ideal I-V characteristics, DC transfer characteristics,

Threshold voltage- Body effect- Design equations- Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models.		
Unit II	**COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS**	**9**
Introduction, Static CMOS Design- Complex Logic Gates, Ratioed Logic, Pass-Transistor Logic, Transmission gate Logic, Dynamic CMOS Logic Design: Dynamic Logic Design Considerations. Static and Dynamic Latches and Registers, Timing issues, pipelining- Speed and Power Dissipation.		
Unit III	**DESIGN OF ARITHMETIC CIRCUITS**	**9**
Adders-Ripple carry, Carry-Look ahead, Multiplier using Array based-Ripple carry adder, Carry Save adder, Multiplier -Wallace Tree, Dadda Tree, Booth, Barrel Shifter, Power and Speed trade-off.		
Unit IV	**IMPLEMENTATION STRATEGIES**	**9**
Full custom and Semi custom design, Standard cell design and cell libraries, Programmable Logic Devices- PLA, PAL, GAL, CPLD. FPGA building block architectures, FPGA interconnect routing procedures.		
Unit V	**VHDL PROGRAMMING**	**9**
RTL Design – Structural level Design -combinational logic – Types – Operators – Packages– Sequential circuit – Sub programs – Test benches. (Examples: adder, counters, flip flops, FSM, Multiplexers / Demultiplexers)		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Analyze the DC and AC characteristics of MOS transistors		
CO2: Design combinational and sequential logic circuits using CMOS and analyze its power strategies		
CO3: Design arithmetic circuits and analyze its performance metrics		
CO4: Understand and Apply implementation of basic circuits using FPGA		
CO5: Understand and use HDL constructs to develop application specific digital architectures.		
Text Books:		
1.Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Pearson Education ASIA, 2nd edition, 2000.		
2. Jan M. Rabaey ,AnanthaChandrakasan, Borivoje. Nikolic, ‖Digital Integrated Circuits:A Design perspective, Second Edition , Pearson , 2016.		
3. Douglas Perry, ‘VHDL Programming By Example’, Tata McGraw Hill, 3rdEdition.2007.		
References:		
1.D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003		
2. Wayne Wolf “Modern VLSI Design System on chip. Pearson Education.2002.		
3. Charles H.Roth, ‘Fundamentals of Logic Design’, Jaico Publishing House, 1992		
4. John P.Uyemura “Introduction to VLSI Circuits and Systems”, John Wiley & Sons, Inc., 2002		
5. Eugene D.Fabricius, Introduction to VLSI Design McGraw Hill International Editions,		

1990.

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3											2	2	
2	3	3	2	2									2	1
3	3	3	2	2									1	1
4	3	2	2			1						2	2	
5	3		2	2	2	1						2	2	

Course Code	Course Title	L	T	P	C
UEE2625	**SWITCHED MODE POWER SUPPLIES**	**3**	**0**	**0**	**3**

Objectives:

- To understand the basic concepts and operation of efficient switched- mode power conversion techniques.
- To provide conceptual knowledge in modern power electronic converters and its applications in electric power utility.

Unit I	**BASIC DC-DC CONVERTER CIRCUITS**	**9**
Operation and design of Buck , Boost , Buck- Boost and Cuk Converters (both CCM & DCM), Choice of switching frequency and applications.		
Unit II	**ISOLATED SMPS**	**9**
Operation and design of Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs.		
Unit III	**CONTROL ASPECTS OF SMPS**	**9**
PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams		
Unit IV	**DESIGN CONSIDERATIONS OF SMPS**	**9**
Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.		
Unit V	**ELECTROMAGNETIC INTERFERENCE (EMI)**	**9**
EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement. Protection - Over current protection, over voltage protection, Inrush current protection, Thermal Model - Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.		
	Total Periods	**45**

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Outline the fundamentals of isolated and non-isolated converter for SMPS.
CO2: Analyze the feedback controller for regulated output voltage.
CO3: Choose appropriate components for the design of SMPS.
CO4: Analyze and simulate various power electronic converter topologies.
CO5: Assess the thermal performance of SMPS, and design suitable filters and heat sink.
Text Books:
1. H. W. Whittington, B. W. Flynn and D. E. MacPherson, Switched Mode Power Supplies, Design and Construction, Universities Press, 2009 Edition.
2. Mohan N. Undeland T. & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2002
References:
1.KreinP.T .Elements of Power Electronics., Oxford University Press
2. M. H. Rashid, Power Electronics. Prentice-Hall of India
3.Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley Eastern Ltd.,1992
4. Robert. W. Erickson, D. Maksimovic , Funda mentals of Power Electronics, Springer International Edition, 2005
5. Course Material on Switched Mode Power Conversion, V. Ramanarayanan

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													
2	3	2			1									
3	3	2	2	2	1								1	2
4	3	2	1	2	3					1		2	1	2
5	2	2	2	2	2								1	2

PROFESSIONAL ELECTIVE- III (SEMESTER – VI)

Course Code	Course Title	L	T	P	C
UEE2626	ENERGY STORAGE SYSTEMS	3	0	0	3

Objectives:

- To understand the concepts and technologies used in various multidisciplinary energy storage devices.
- To understand selection and sizing of a suitable energy storage device for a specific application.
- To learn the energy storage management for grid connected power systems.

Unit I	**THERMAL ENERGY STORAGE**	**9**

Thermal Energy - Principle - Benefits - Criteria for Evaluation - Operating Characteristics - Sensible, Latent and Cold Thermal Energy Storage - Heating and Cooling Applications

Unit II	**ELECTROCHEMICAL ENERGY STORAGE**	**9**

Battery composition, Construction and Principle of operation of Secondary batteries - Modern batteries - Flow batteries - High temperature batteries; Fuel Cells - Operation, Types

Unit III	**ELECTROMAGNETIC ENERGY STORAGE**	**9**

Energy Storage in Capacitors - Supercapacitors - Principle - Charging and Discharging Characteristics - Types - Equivalent Circuits; Superconducting magnetic energy storage - Principles - Superconducting coils - Cryogenic systems- Energy transfer efficiency

Unit IV	**MECHANICAL ENERGY STORAGE**	**9**

Flywheel storage - Structure - System dynamics - Operation; Compressed air energy storage- Principle - Function - Technical characteristics; Pumped hydro storage - Principle - power extraction system

Unit V	**ENERGY STORAGE MANAGEMENT**	**9**

Techno-Economic Analysis - Estimation of Energy Storage - Dynamic Energy Storage Management for dependable Renewable Electricity Generation - Energy Storage Installations in the Power System - Grid Tied AC Microgrid Applications

Total Periods	**45**

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

CO1: Describe the thermal energy storage systems and their applications.

CO2: Illustrate the operating principles of electrochemical energy storage systems.

CO3: Summarize the principles underpinning the operation of electromagnetic energy storage systems.

CO4: Explain the operation of mechanical energy storage systems.

CO5: Solve the grid integration issues of renewable energy sources by energy storage techniques.

Text Books:

1. J. K. Kaldellis, Stand-alone and Hybrid Wind Energy Systems -Technology, Energy Storage and Applications, Woodhead Publishing Series in Energy, CRC Press, 2010

2. Rosario Carbone, Energy Storage in the Emerging Era of Smart Grids, 2011, InTech

References:
1. Frank S. Barnes & Jonah G. Levine, Large Energy storage Systems Handbook, CRC Press, 2011.
2. Ziad Melhem, Electricity transmission, distribution and storage systems, Woodhead Publishing Series in Energy, 2013.
3. H. P. Garg, S. C. Mullick, A. K. Bhargava, Solar Thermal Energy Storage,Springer, 1985.
4. Artur Braun,Electrochemical Energy Systems- Foundations, Energy Storage and Conversion, De Gruyter, CPI Books, 2018.
5. Robert A. Huggins, Energy Storage, Springer, 2010.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1		3	2	2	2								1	3
2		3	2	2	2									2
3		3	2	2	2								1	2
4		3	2	2	2									2
5		3	3	2	2					2			2	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2627	**SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL**	**3**	**0**	**0**	**3**

Objectives:

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models (BJ/MA/ARX/ARMAX etc.) using least squares method and recursive parameter estimation methods.
- To enable the student to tune the PID controller parameters using various auto tuning methods applied to real time systems.
- To make the student understand the principles of STR, MRAC and Gain scheduling with real time applications
- To make the student design simple adaptive controllers for linear systems using above methods.

Unit I	**NON-PARAMETRIC METHODS**	**8**

Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification

Unit II	**PARAMETRIC METHODS**	**8**

Least squares estimation – Analysis of the least squares estimate - Best linear unbiased

estimate – Model parameterizations - Prediction error methods.		
Unit III	**RECURSIVE IDENTIFICATION METHODS**	**9**
The recursive least square methods - Model validation –Model structure determination - Introduction to closed loop system identification.		
Unit IV	**ADAPTIVE CONTROL SCHEMES**	**10**
Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling – Conical Tank System Example.		
Unit V	**MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR)**	**10**
STR – Pole placement design – Indirect STR and direct STR – MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR - Design of minimum variance controller - Design of moving average controller -stochastic self-tuning regulators		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Ability to understand various system identification techniques and features of adaptive control like STR and MRAC.		
CO2: Ability to analyze with the analytical concepts of system identification and adaptive control		
CO3: Ability to understand about Black-box approach-based system identification.		
CO4: Ability to Explain the Pontryagin Minimum Principle.		
CO5: Ability to get knowledge about batch and recursive identification.		
Text Books:		
1.T.Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989		
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009.		
3.Arun.KTangirala, “Principles of System Identification – Theory and Practice”, CRC Press, 2015.		
References:		
1. L. Ljung, System Identification - Theory for the User, 2nd edition, PTR Prentice Hall, 112 Upper Saddle River, N.J., 1999.		
2. K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Prentice-Hall, 1989.		
3. H. K. Khalil, Nonlinear Systems, Prentice Hall, 3rd edition, 2002.		
4. William S.Levine, “Control Systems Advanced Methods, the Control Handbook, CRC Press 2011.		
5. S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1989		

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3				3							3			
2	3	1	2	2	2	1				1		2			
3	3		2		2	2						3			
4			2		2	2									
5				1	1					1	1				

Course Code	Course Title	L	T	P	C
UEE2628	ARTIFICIAL INTELLIGENCE FOR POWER SYSTEMS	3	0	0	3

Objectives:

- To introduce operating principles of Intelligent System and Evolutionary programming techniques.
- To explain the application of Intelligent system and Evolutionary programming techniques to power system problems like optimal power flow, voltage and var control, vulnerability assessment and control co-ordination problems

Unit I	**INTELLIGENT SYSTEM**	**9**

Expert Systems –Architecture and Implementation – Fuzzy Logic Systems – Implementation approach – Algorithm – Artificial Neural Network – Overview and Formulation

Unit II	**EVOLUTIONARY PROGRAMMING**	**9**

Particle Swarm Optimization – Formulation and Algorithm – Ant Colony Optimization – Formulation and Algorithm – Genetic Algorithm – Implementation and Algorithm – Tabu search – Tabus and procedure for developing Tabus

Unit III	**OPTIMAL POWER FLOW PROBLEM**	**9**

OPF formulation – Application of ANN, Fuzzy Logic, Genetic Algorithm, Evolutionary Programming – Tabu Search – PSO and Ant Colony Optimization – Case Study

Unit IV	**VOLTAGE AND VAR CONTROL**	**9**

Models and formulation – Application of Fuzzy Logic, PSO, Genetic Algorithm and Ant Colony Optimization – Case Study

Unit V	**VULNERABILITY ASSESSMENT AND CONTROL COORDINATION**	**9**

Vulnerability Assessment – Generalized model – Challenges – Application of ANN, PSO and Genetic Algorithm – Case study

Control Coordination – Problem definition and formulation - Application of Fuzzy Logic, Particle Swarm Optimization, Genetic Algorithm and Ant Colony Optimization – Case study

Total Periods	**45**

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

CO1: Understand and comprehend the principles lying behind Expert Systems, Fuzzy

Logic Systems and Artificial Neural Network.
CO2: Understand and comprehend the principles lying behind Evolutionary program techniques like PSO, ACO, GA, EP, TS.
CO3: Apply Intelligent system technique and EP based technique to solve complex non-linear optimal power flow problem.
CO4: Apply Intelligent system technique and EP based technique to voltage and VAR control problems in power system.
CO5: Apply Intelligent system technique and EP based technique to Vulnerability Assessment Control Coordination in power System.
Text Books:
1. Momoh, James A, "Adaptive stochastic optimization techniques with applications" CRC Press, 2016.
2. Kevin Warwick, Arthur Ekwue and Raj Aggarwal, "Artificial Intelligence Techniques in Power Systems" IET Power and energy series, First edition, 1997.
3. W Ongsakul, D.N Vo,"Artificial Intelligence in Power System Optimization", CRC Press, 2013
References:
1. James A. Momoh, Mohamed E. El-Hawary,"Electric Systems, Dynamics, and Stability with Artificial Intelligence Applications" Power Engineering – CRC Press (1999)
2. Erik Cuevas, Emilio Barocio Espejo, Arturo Conde Enríquez,"Metaheuristics Algorithms in Power Systems" Springer International Publishing, 2019
3. Ahmed F. Zobaa, Alfredo Vaccaro, "Computational Intelligence Applications in Smart Grids_ Enabling Methodologies for Proactive and Self-Organizing Power Systems", Imperial College Press, 2015.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3		3	3							1		
2	3	3		3	3							1		
3	3	3	2	3	3							1	1	
4	3	3	2	3	3							1	1	
5	3	3	2	3	3							1	1	

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2629	**AUTOMOTIVE ELECTRONICS**	**3**	**0**	**0**	**3**

Objectives:

- To understand the emission standards of automotive electronic systems
- To understand the electronic modules used in automotive applications such as ignition system, engine control system, sensors and actuators

- To gain knowledge about the chassis design and safety standards for automotive electronics

Unit I	**INTRODUCTION**	**8**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

Unit II	**IGNITION AND INJECTION SYSTEMS**	**10**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

Unit III	**SENSOR AND ACTUATORS IN AUTOMOTIVES**	**7**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

Unit IV	**ENGINE CONTROL SYSTEMS**	**10**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

Unit V	**CHASSIS AND SAFETY SYSTEMS**	**10**

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

Total Periods	**45**

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

CO1: Know the importance of emission standards in automobiles.

CO2: Understand the electronic fuel injection/ignition components and their function

CO3: Choose and use sensors and equipment for measuring mechanical quantities, temperature and appropriate actuators.

CO4: Analyses the chassis and vehicle safety system.

CO5:Analyse various methods of power system earthing.

Text Books:

1. Ribbens,"Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2013

References:

1. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 2001

2. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 2000.

3. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

4. Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers, 2000.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2				3	3							2
2	3	2	2	1			1						2	2
3	3	2	2	1			1						2	2
4	3	3	2			1	2							2
5	3	2	2	1		3	2						1	2

Course Code	Course Title	L	T	P	C
UEE2631	ELECTRICAL MACHINE DESIGN	3	0	0	3

Objectives:

- To impart knowledge on the following topics:
- Influence of magnetic circuit parameters and thermal rating of various types of electrical machines and their design considerations
- Design of Armature and field systems of D.C. machines and Core, yoke, windings and cooling systems of transformers.
- Design of stator and rotor of induction machines and synchronous machines.
- The importance of computer aided design methods and use it for the design of special machines like brushless dc, permanent magnet synchronous machines, switched reluctance and synchronous reluctance machines

Unit I	FUNDAMENTAL ASPECTS OF ELECTRICAL MACHINE DESIGN	9

Design of Machines, Design Factors, Limitations in design, Modern Trends in design, manufacturing Techniques. Dimensions and Rating of Machines, Materials for Electrical Machines, Heating and Cooling of Machines, Magnetic Circuit Calculations, Calculation of MMF, Estimation of True and Apparent Flux Densities, Iron Losses, Leakage Calculations, thermal rating

Unit II	DESIGN OF DC MACHINES AND TRANSFORMERS	9

Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.

Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and

Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling		
Unit III	**DESIGN OF THREE PHASE INDUCTION MOTORS**	**9**
Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance.		
Unit IV	**DESIGN OF THREE PHASE SYNCHRONOUS MACHINES**	**9**
Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.		
Unit V	**COMPUTER AIDED DESIGN AND ANALYSIS OF SPECIAL MACHINES**	**9**
Introduction to Finite element method - historical background, applications, advantages. Study of new computer aided machine software using Finite Element. Case study: Complete design of Switched Reluctance machine, Permanent Magnet Synchronous Machine Design of Brushless DC machine Design of Synchronous reluctance machine		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Understand basics of design considerations for rotating and static electrical machines and appreciate the importance of magnetic circuit calculations		
CO2: Design and analyze single, three phase transformer and DC machines		
CO3: Design and analyze stator and rotor of induction motor		
CO4: Design and analyze stator and rotor of synchronous motor		
CO5: Design of special machines by computer aided methods		
Text Books:		
1. Sawhney, A.K., ‘A Course in Electrical Machine Design’, Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.		
2. V Rajini, V.S Nagarajan, ‘Electrical Machine Design’, Pearson, 2017.		
References:		
2. V.N. Mittle and A. Mittle, ‘Design of Electrical Machines’, Standard Publications and Distributors, Delhi, 2002.		
3. Sen, S.K, "Principles of Electric Machine Design with Computer Programmes", Oxford & IBH Publishing Co. Pvt. Ltd., 2001, Reprint 2004.		
4. M.V.K. Chari and P.P. Silvester, "Finite Elements in Electric and Magnetic Field Problems", John Wiley, 1980.		
5. K.G. Upadhyay, ‘Design of Electrical Machines’, New Age International Publishers,2008.		
6. R.K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi, 2002.		
7. Shanmugasundaram, A., GangadharanG. and Palani R., "Electrical Machine Design Data Book", New Age international publishers (P) ltd., First edition 17979, Reprint 2005.		

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	1	3	3	2		1	1	1	1	3	3
2	3	3	3	1	3	3	2		1	1	1	1	3	3
3	3	3	3	1	3	3	2		1	1	1	1	3	3
4	3	3	3	1	3	3	2		1	1	1	1	3	3
5	2	2	2	2	2	2			2	2	1	3	3	3

PROFESSIONAL ELECTIVE – IV (SEMESTER- VII)

Course Code	Course Title	L	T	P	C
UEE2721	SMART GRID	3	0	0	3

Objectives:

- To understand the function of smart grid and the components used in it.
- To understand various technologies and control used in smart grid.

Unit I	**INTRODUCTION TO SMART GRID**	**9**

Evolution of Electric Grid, Need for Smart Grid, Difference between conventional &Smart Grid, Smart grid drivers, Benefits, Functions of smart grid components, Overview of the technologies required for the Smart Grid, National and International Initiatives in Smart Grid.

Unit II	**SMART GRID TECHNOLOGIES**	**9**

Technology Drivers, Smart energy resources: Renewable generation, Energy storage, Electric Vehicles, Microgrids, Smart substations: protection, monitoring and control, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers.Distribution automation equipment.

Unit III	**SENSING, CONTROL AND AUTOMATION TECHNOLOGIES**	**9**

Smart metering, Smart meters: An overview of the hardware used, Communications infrastructure and protocols for smart metering, Advanced Metering Infrastructure (AMI), AMI Drivers and Benefits, AMIN needs in smart grid, AMI standards and security, Demand-side integration.

Unit IV	**COMMUNICATION TECHNOLOGIES FOR THE SMART GRID**	**9**

Data communication- Switching techniques, Communication channels, Layered architecture and protocols, Communication Technologies-Communications Requirements for the Smart Grid, Wireless Network Solutions, Communication Standards and Protocols, Standards for information exchange, Communications Challenges in the Smart Grid.

Unit V	**HIGH PERFORMANCE COMPUTING AND CYBER SECURITY**	**9**

Computational Challenges in a Smart Grid, Existing Functions Improved and New Functions Enabled by HPC, Cyber security in the Smart Grid- Definitions, Security Functions, Security Threats, Cyber security in the Smart Grid, Digital signatures, Cyber security standards.

Total Periods	**45**

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

CO1: Explain the concepts of smart grid and its latest developments

CO2: Describe the different smart grid technologies in energy utilization, control and automation

CO3: Illustrate smart metering infrastructure and demand side management
CO4: Explain the data communication and computing techniques for smart grid applications
CO5: Describe high performance computing and information security for smart grid
Text Books:
1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions",CRC Press 2013.
2.JanakaEkanayake,NickJenkins,KithsiriLiyanage,JianzhongWu,AkihikoYokoyama, "Smart Grid: Technology and Applications",Wiley 2012.
References:
1. James Momoh, "Smart Grid Fundamentals of Design and Analysis", Wiley, 2012 .
2. Tony Flick, Justin morehouse, "Securing the smart grid: Next generation power grid security", Elsevier, 2010
3. Daphne Mah, Peter Hills, Victor O.K. Li, Richard Balme -Smart Grid Applications and Developments-Springer, 2014.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			1								1		2
2	3	2		1									1	2
3	3	2		1	1								1	3
4	3	2	2	1								1		2
5	3		2	1								1	1	2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2722	**PRINCIPLES OF ROBOTICS**	**3**	**0**	**0**	**3**

Objectives:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

Unit I	**BASIC CONCEPTS – CONFIGURATION SPACE & RIGID BODY MOTION**	**9**

Robot Mechanism – Types, Joints – Degree of freedom – configuration space and constraints- -Rotation- linear and angular velocities- Homogeneous transformation matrix – twists –wrench –exponential coordinate representation of rigid body

Unit II	**FORWARD KINEMATICS AND MANUPLATOR MOTION**	**9**

Mathematical representation - DenavitHatenberg parameters - Product of exponents -

Manipulator Jacobian – Singularity analysis – Manipulability – static analysis – force and motion balance		
Unit III	**INVERSE AND DIFFERENTIAL KINEMATICS**	**9**
Inverse Kinematics PUMA 6R & Stanford Type arm robots- Solvability - Solution methods- Closed form solution-numerical algorithms – Differential Kinematics - Stewart Gough platform – General Parallel Mechanis		
Unit IV	**TRAJECTORY AND MOTION PLANNING**	**9**
Point to Point trajectories - Joint space technique- Time Scaling - Use of p-degree polynomial-Cubic polynomial- S-Curve - Cartesian space technique – Methods of motion planning –Grid method - Graph search -A* search- Sampling method – Rapid Exploring Random Tree (RRT) & Probabilistic Road map (PRM)		
Unit V	**DYNAMICS AND CONTROL**	**9**
Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation- Newton Euler formulation – Constrained dynamics -Manipulator control problem-Linear control schemes-PID control scheme-Motion control - Force control and Impedance control of robotic manipulator.		
	Total Periods	**45**

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Understand the dynamics of Robot in constrained space.
CO2: Understand and Analyze Forward Kinematics and differential motion.
CO3: Ability to Apply Different Control techniques to Robotics
CO4: Ability to Apply Trajectory and Motion planning in Robotics.
CO5: Ability to understand and analyse Robotic systems and their applications to various industries
Text Books:
1. Kevin M. Lynch & Frank C. Park, Modern Robotics Mechanics, Planning, and Control, Cambridge University press, 1st Print ,2017
2.R.K.Mittal and I.J.Nagrath, Robotics and Control,Tata McGraw Hill,New Delhi,4th Reprint, 2005.
3.JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009
4.M.P.Groover, M.Weiss,R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996
References:
1.AshitavaGhoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.AppuKuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4.R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.

COs	**POs**	**PSOs**

	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3											3	3
2	3	3											3	3
3				3	2								3	3
4				3	2								3	3
5	3	3	3	3									3	3

Course Code	Course Title	L	T	P	C
UEE2723	**INTERNET OF THINGS IN POWER SYSTEM ENGINEERING**	**3**	**0**	**0**	**3**

Objectives:

- To understand the basics of IoT and its architecture
- To learn the various IoT protocols
- To implement big data analytics and use cloud computing for real-time applications in power system

Unit I	**BASICS OF IoT**	**9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack –- Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

Unit II	**IoT PROTOCOLS**	**9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE802.15.4,802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IPversions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application TransportMethods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

Unit III	**DESIGN AND DEVELOPMENT**	**9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips – IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi – Interfaces and Raspberry Pi with Python Programming.

Unit IV	**DATA ANALYTICS AND SUPPORTING SERVICES**	**9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of MachineLearning –No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

Unit V	**CASE STUDIES/INDUSTRIAL APPLICATIONS**	**9**

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart

and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart TrafficControl
Total Periods **45**
Course Outcomes: Upon successful completion of the course, students will be able to
CO1 Explain the concept of IoT.
CO2: Analyze various protocols for IoT.
CO3: Design a PoC of an IoT system using Rasperry Pi/Arduino
CO4: Apply data analytics and use cloud offerings related to IoT.
CO5: Analyze applications of IoT in real time scenario in Electric
Text Books:
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, ―IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
References:
1.ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach,Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi, ―The Internet of Things – Keyapplications and Protocols, Wiley, 2012 (for Unit 2).
3. Jan Ho¨ ller, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internetof Things I, Springer, 2011.
5.Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2 nd Edition, O'Reilly Media, 2011.
6. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		1		1								1	
2	3		1		2	1	1	1			2	2	1	
3	3		3		2	1	1	2			2	2	1	
4	3		3		3	1	2	2			2	2		
5	3		3	1	3	1	2	2			3	2		

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2724	**POWER SEMICONDUCTOR DEVICES**	3	0	0	3
Objectives:					

The student should be made to:

- Understand the static and dynamic characteristics of various current controlled and voltage controlled power semiconductor devices.
- Learn the advanced devices and new materials for power devices
- Explore the design and selection of devices for different power electronics applications.
- Familiarize the control and firing circuit for different power devices

Unit I	**INTRODUCTION**	**9**

Power switching devices overview – Attributes of an ideal switch, application requirements, Safe operating Area; Device selection strategy – On-state and switching losses, EMI due to switching - Power diodes - operation, static and switching characteristics- Types.

Unit II	**CURRENT CONTROLLED DEVICES**	**9**

BJT– Construction, static and switching characteristic, second breakdown; - Thyristors – Operating mode, Two transistor analogy; Gate and switching characteristics; Gate turn-off thyristors; comparison of BJT and Thyristor.

Unit III	**VOLTAGE CONTROLLED DEVICES**	**9**

Principle of voltage controlled devices; Power MOSFETs and IGBTs – construction, types, equivalent circuits, static and switching characteristics, Comparison.

Unit IV	**EMERGING DEVICES**	**9**

MCT, FCT, RCT, IGCT; New semiconductor materials for devices – Super junction Structures, Silicon Carbide Power Devices, Gallium Nitride Power Devices – Power Integrated Circuits

Unit V	**FIRING AND PROTECTING CIRCUITS**	**9**

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Snubber circuits; Thermal protection - heat sink types and design

Total Periods	**45**

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

CO1: determine the suitable device for an application

CO2: describe the physical operation and characteristics of power semiconductor device

CO3: emphasize the principle of advanced power devices and new materials for device fabrication

CO4: design of protection circuits and control circuits

CO5: to determine the reliability of the system

Text Books:

1. Mohan, Undeland and Robins, Power Electronics – Concepts, Applications and Design, John Wiley and Sons, Singapore, 2000.
2. Yung C Liang, Ganesh S Samudra, Chih-Fang Huang, Power Microelectronics: Device and Process Technologies World Scientific, 2nd Edition, 2017.
3. Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, Third Edition, New Delhi, 2004.

References:

1. Williams B.W., Power Electronics Circuit Devices and Applications.
2. Singh M.D., and Khanchandani K.B., Power Electronics, Tata McGraw Hill, 2001.
3. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw- Hill, 2010.
4. P. S. Bimbhra, Power Electronics, Khanna Publishers.

Cos	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	2											2
2	3	3	2											2
3	3	3	2	2										2
4	3	3	2	2								1		2
5	3	3	2									1		2

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2725	**FLEXIBLE AC TRANSMISSION SYSTEMS AND CUSTOM POWER DEVICES**	**3**	**0**	**3**	**3**

Objectives

- To identify the need for FACTS controllers along with the classification of various FACTS controllers under certain sub-categories based on the power electronic components and connection.
- To analyze the various application of SVC, TCSC and Voltage Source Converter based FACTS controllers.

Unit I	**INTRODUCTION**	**9**
Control of power flow in AC transmission line, analysis of uncompensated line, passive reactive power compensation - effect of series and shunt compensation on power transfer capability, need for FACTS controllers, classification of FACTS controllers - FACTS vs custom power devices.		
Unit II	**STATIC VAR COMPENSATOR (SVC)**	**12**
Analysis of Thyristor Controlled Reactor (TCR), configuration of SVC, voltage control by SVC, modelling of SVC for load flow and transient stability studies, design of SVC voltage regulator based on the concept of system gain, Applications: transient stability enhancement - power oscillation damping and prevention of voltage instability.		
Unit III	**THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)**	**9**
Need for controlled series compensation, modes of operation of TCSC, modelling of TCSC for load flow and transient stability studies, applications of TCSC.		
Unit IV	**VOLTAGE SOURCE CONVERTER BASED FACTS**	**9**

	CONTROLLERS	
Operation of Static Synchronous Compensator (STATCOM) and Static Synchronous Series Compensator (SSSC), power flow control with STATCOM and SSSC, modes of operation in Unified Power Flow Controller (UPFC) - applications.		
Unit V	**CO-ORDINATION OF FACTS CONTROLLERS**	**6**
Controller interactions, SVC–SVC interaction, Co-ordination of multiple controllers using linear control techniques, Control co-ordination using Genetic Algorithm (GA).		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Summarize the need for FACTS controllers based reactive power compensation.		
CO2: Analyze the various application of SVC and subsequently model SVC for power system studies.		
CO3: Analyze the need for variable series compensation and elaborate the operation of TCSC.		
CO4: Analyze the operation of Voltage Source Converter based FACTS controllers.		
CO5: Describe the FACTS controller interaction and control coordination.		
Text Books:		
1. R. MohanMathur, Rajiv K.Varma, " Thyristor - Based FACTS Controllers for Electrical Transmission Systems ", IEEE press and JohnWiley& Sons, Inc, 2002.		
2.Narain G. Hingorani, " Understanding FACTS - Concepts and Technology of Flexible AC Transmission Systems ", Standard Publishers Distributors, Delhi, 2011.		
References:		
1. K.R. Padiyar, " FACTS Controllers in Power Transmission and Distribution ", New Age International (P) Limited, Publishers, New Delhi, 2008.		
2. V.K. Sood, " HVDC and FACTS controllers - Applications of Static Converters in Power System ", Kluwer Academic Publishers, 2004.		

COs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	1										
2	3	3	3	3	3										
3	3	3													
4	3	3													
5	3	3													

PROFESSIONAL ELECTIVE - V (SEMESTER – VII)

Course Code	Course Title	L	T	P	C
UEE2726	DISTRIBUTED GENERATION AND MICRO GRID	3	0	0	3

Objectives:

To impart knowledge about the following topics:

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration

Unit I	**INTRODUCTION**	**9**

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

Unit II	**DISTRIBUTED GENERATIONS (DG)**	**9**

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

Unit III	**IMPACT OF GRID INTEGRATION**	**9**

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

Unit IV	**BASICS OF A MICROGRID**	**9**

Concept and definition of microgrids, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrids, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

Unit V	**CONTROL AND OPERATION OF MICROGRID**	**9**

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Total Periods	**45**

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

CO1: Understand the knowledge on the various schemes of conventional and nonconventional power generation.

CO2: Understand the knowledge on the topologies and energy sources of distributed generation.
CO3: Understand and analyse the requirements for grid interconnection and its impact with NCE sources
CO4: Understand the fundamental concept of Microgrid.
CO5: Analyze power quality issues and control operation of micro grid.
Text Books:
1.Gevork B. Gharehpetian, S. Mohammad Mousavi Aga, " Distributed Generation Systems: Design, Operation and Grid Integration ", Elsevier, 2017.
2. S. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks", Institution of Engineering and Technology, 2009.
References:
1.AmirnaserYezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modelling, Control and Applications”, IEEE John Wiley Publications, 2010.
2.DorinNeacsu, “Power Switching Converters: Medium and High Power”, CRC Press, Taylor & Francis, 2006.
3. Chetan Singh Solanki, “Solar Photo Voltaics”, PHI learning Pvt. Ltd., New Delhi,2009.
4. J.F. Manwell, J.G. McGowan “Wind Energy Explained, theory design and applications”, Wiley publication 2010.
5. D. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, John Wiley, New York, 1987.
6. John Twidell and Tony Weir, “Renewable Energy Resources” Taylor and Francis Publications, Second edition 2006.

COs	**Pos**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													1
2	3	2		2										1
3	3	3	3	2		1	1		1	1		1	1	2
4	3	2			2		1			1		1	1	2
5	3	3	3	2	2	1	1		1	1		1	2	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2727	**PLC AND SCADA**	**3**	**0**	**0**	**3**

Objectives:

- To understand automation and control system
- To understand general PLC and related issues
- To understand the operation of a PLC, Programming of PLCs

- To understand and able to write simple ladder logic programs
- Working with SCADA software, implementation of Distributed Control Scheme

Unit I	**INTRODUCTION TO AUTOMATION**	**9**
Brief Description of a Control System, Pneumatic Controller, PID Controller, PLC Controller, History & Need of Industrial Automation, Application of Industrial Automation, Basic Components of Automation, Hardware Classification of Automation		
Unit II	**GETTING FAMILIAR WITH PLC**	**9**
Type of PLC, Hardware & Architecture of PLC, Application and Advantage of PLCs, Sourcing and Sinking concept, Programming Language of a PLC. Introduction to field Device (Input / Output), Data files in PLC Programming, Brief Description of a Logic Gates, Simulator analysis of a PLC Programming, Communication with PLC, Wiring different field device to PLC, Uploading, Downloading & Monitoring programs. Introduction to SFC, Introduction to Instruction List, Introduction to Ladder Logic		
Unit III	**ADVANCE PROGRAMMING IN PLC**	**9**
Introduction to jump and label instruction, Introduction to SBR and JSR instruction, Forcing of I/O, Monitoring/Modifying Data table values, Hands on experience on real time applications, Fault finding/troubleshooting and documentation. Interfacing proximity sensor with PLC, Interfacing with Relay, Control circuit designing with feedback concept		
Unit IV	**LADDER LOGIC PROGRAMMING**	**9**
Comparison b/w Gates, Relay Logic & ladder logic, Description of using Memory bit in a programming, Mathematical Concept ADD, SUB, MUL, DIV and etc. Logical Concept AND, ANI, OR, ORI, EXOR, NOT etc, Special Function, MOV, SET, RST, CMP, INC, DEC, Programming based on Timer and Counter		
Unit V	**GETTING FAMILIAR WITH SCADA**	**9**
Introduction to SCADA Software, Creating new SCADA Project, GUI Designing, Tag Substitutions, Dynamic Process Mimic, Real Time Trend, Historical Trend, How to create Alarms & Event, Recipe Management. Introduction to graphic Properties like Sizing, Blinking, Filling, Analog Entry, Movement of Objects, Visibility etc., Net DDE Communication, Application of scripts, Communication with PLC		
	Total Periods	**45**

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

CO1: Explain the concept of automation and control system

CO2: Explain general PLC and related issues

CO3: Explain the operation of a PLC, Programming of PLCs

CO4: Write simple ladder logic programs

CO5: Explain the working of SCADA software, implementation of Distributed Control Scheme

Text Books:

1. Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson, 2nd Edition

2. John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications

3. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and

Application", 5th Edition
4. Ronald L. Krutz, "Securing SCADA System", Wiley Publishing
5. Stuart A Boyer, "SCADA supervisory control and data acquisition"
References:
1. Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition
2. Bennett Stuart, "Real Time Computer Control", Prentice Hall, 1988
3.Doebelin E. O., "Measurement Systems", McGraw-Hill International Editions, Fourth Edition, 1990
4. Gordan Clark, Deem Reynders, "Practical Modem SCADA Protocols"
5. Krishna Kant, "Computer Based Industrial Control", PHI
6. M. Chidambaram, "Computer Control of Process", Narosha Publishing
7. P. K. Srivstava, "Programmable Logic Controllers with Applications", BPB Publications
8.PoppovikBhatkar, "Distributed Computer Control for Industrial Automation", Dekkar Publications
9. S. K. Singh, "Computer Aided Process Control", PHI
10. Sunil S. Rao, "Switchgear and Protections", Khanna Publication
11. Webb J. W, "Programmable Controllers", Merrill Publishing Company, 1988

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3		3		2	1	2	2			2	2	1	
2	3		3		2	1	2	2			2	2	1	
3	3		3		2	1	2	2			2	2	1	
4	3		3		2	1	2	2			2	2	3	3
5	3		3		2	1	2	2			3	2	1	

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2728	**POWER SYSTEM TRANSIENTS**	**3**	**0**	**0**	**3**

Objectives:

- To study the different types, causes and effects of power system transients
- To study the mechanism of lighting strokes.
- To understand the generation of switching transients.
- To understand and analyse the propagation, reflection and refraction of travelling waves in power transmission lines.
- To analyse the impact of voltage transients caused by various types of faults in integrated power system.

Unit I	**INTRODUCTION**	**9**

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.		
Unit II	**SWITCHING TRANSIENTS**	**9**
Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transientvoltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.		
Unit III	**LIGHTNING TRANSIENTS**	**9**
Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires – tower footing resistance - Interaction between lightning and power system.		
Unit IV	**TRAVELING WAVES ON TRANSMISSION LINE**	**9**
Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram – standing waves and natural frequencies - reflection and refraction of travelling waves.		
Unit V	**TRANSIENTS IN INTEGRATED POWER SYSTEM**	**9**
The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults –switching surges on integrated system Qualitative application of EMTP for transient computation		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Ability to study various types and causes of power system transients and study the effect of transients on power systems		
CO2: Ability to understand the generation of switching transients and their control using circuit – theoretical concept.		
CO3: Ability to study the mechanism of lighting strokes and the production of lighting surges.		
CO4:Ability to analyse the propagation, reflection and refraction of travelling waves.		
CO5:Ability to analyse the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.		
Text Books:		
1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.		
2.PritindraChowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc.,Second Edition, 2009.		

3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

References:

1.M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.

2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited,1986.

3.Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.

4.J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	3										
2	3	3	3	2	3										
3	3	3	3	2	3										
4	3	3	3	2	3										
5	3	3	3	2	3										

Course Code	Course Title	L	T	P	C
UEE2729	EMBEDDED SYSTEMS	3	0	0	3

Objectives:

- To understand the Building Blocks and architectures of Embedded System
- To learn various communication protocols used in Embedded networking
- To gain knowledge about RTOS and embedded system based application development

Unit I	INTRODUCTION TO EMBEDDED SYSTEM	9

Introduction to Embedded Systems –Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

Unit II	EMBEDDED NETWORKING	9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –Ethernet - need for device drivers.

Unit III	EMBEDDED ARCHITECTURES	9

Instruction Set Architecture-CISC architecture [8051] and RISC instruction set architecture [ARM processors], DSP Processors, Harvard Architecture-PIC. Coprocessors and Hardware Accelerators, Processor Performance Enhancement-Pipelining, Super-scalar Execution, CPU Power Consumption, Memory System Architecture-, Caches, Virtual Memory, Memory management unit and address Translation.

Unit IV	RTOS BASED SYSTEM DESIGN	9
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance		
Unit V	**EMBEDDED SYSTEM APPLICATION**	**9**
Open-loop and Closed Loop Control Systems-Application Examples-Washing Machine, Automotive Systems, Smart Card system, Auto-focusing digital camera, Air-conditioner, Elevator Control System, ATM System.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Explain and use the basic modules of embedded system		
CO2: Explain and use fundamentals and standards of communication framework among the modules of embedded system		
CO3: Select a suitable processor for the system design		
CO4: Illustrate the salient features in designing a real time system using RTOS		
CO5:Analyse and understand various case studies of system development.		
Text Books:		
1.Peckol, “Embedded system Design”, John Wiley & Sons,2010		
2. Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mcgraw Hill, 2017.		
References:		
1. Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, McGraw Hill, 2013.		
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013		
3.C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.		
4. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.		
5. Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.		
6.Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.		
7. David E. Simon, “An Embedded Software Primer”, Pearson Education, 1999.		
8.Waynewolf, “Computers as components”, Morgan Kaufmann publishers, 2nd Edition2008.		
9.Dr. Prasad, “Embedded Real Time System”, Wiley Dreamtech, 2004.		
10. Jean J.Labrosse, “Embedded system building blocks”, CMP books, 2ndEdition, 1999.		

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3												2	
2	3		2										2	2
3	3	2	2										2	2
4	3			2	2								1	
5	2	3	3	3	2	1						2	1	2

Course Code	Course Title	L	T	P	C
UEE2731	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	3	0	0	3

Objectives:

- To understand the principles and types of HVDC system.
- To familiarize with the control and protection techniques in HVDC system

Unit I	**INTRODUCTION**	**9**

Development of HVDC technology, Advantages of HVDC Systems, HVDC System Costs, Overview and Organization of HVDC Systems, HVDC System Reliability, HVDC Characteristics and Economic Aspects, Planning for HVDC transmission, Modern trends in HVDC technology, HVDC Applications.

Unit II	**ANALYSIS OF HVDC CONVERTERS**	**9**

Basic conversion principle, Selection of converter configuration, Commutation process, Rectifier and inverter operation, Analysis of Graetz circuit with and without overlap, Converter bridge characteristics.

Unit III	**CONTROL OF HVDC CONVERTERS AND SYSTEMS**	**9**

Principles of DC link control, Converter control - characteristics, System control hierarchy, Firing angle control, Current and extinction angle control, Starting and stopping of DC link, Power control, Higher level controllers, HVDC Control Functions.

Unit IV	**REACTIVE POWER CONTROL AND HARMONICS**	**9**

Reactive power requirements in steady state,Sources of reactive power,Static VAR systems, Generation of harmonics, Effect of increasing pulse number, Determination of resulting harmonic impedance, AC filters, DC side filters, Active power filters.

Unit V	**FAULT DEVELOPMENT AND PROTECTION**	**9**

Converter disturbances, AC system fault, DC line fault, Fault analysis, Valve protection functions, Protective action of an HVDC system, Protection by control actions, DC line protection, Filter protection

Total Periods	**45**

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

CO1: Explain the principle and types of HVDC system

CO2: Analyze HVDC converters and their performance characteristics

CO3: Describe the control of converters and reactive power management in HVDC

CO4: Analyze the harmonics and fault conditions in HVDC

CO5: Design the controllers, filters and protection circuits for HVDC

Text Books:

1.Padiyar,K.R.,"HVDC power transmission system", New Age International(P)Ltd. NewDelhi, Second Edition,2010.

2.Arrillaga,J.,"High Voltage Direct Current Transmission", Peter Pregrinus, London,1983.

3.DraganJovcic and Khaled Ahmed, High Voltage Direct Current Transmission: Converters, Systems and DC Grids, Wiley, 2015.

References:

1.KundurP.,“ Power System Stability and Control”, McGraw-Hill,1993.
2. Colin Adamson and HingoraniNG,“ High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
3. Edward Wilson Kimbark,“ Direct Current Transmission”, Vol.I, Wiley inter science, New York, London, Sydney,1971.
4. Chan-Ki Kim, “HVDC TRANSMISSION Power Conversion Applications in Power Systems”, John Wiley & Sons Pvt. Ltd., 2009

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3			1								1		
2	3	2			1									
3	3	2	2											
4	3	2			1								2	1
5	3	2	2	2	3							2	2	1

PROFESSIONAL ELECTIVE – VI (SEMESTER – VIII)

Course Code	Course Title	L	T	P	C
UEE2821	ELECTRIC VEHICLES AND POWER MANAGEMENT	3	0	0	3

Objectives:

- To provide knowledge about electric vehicle architecture and power train components.
- To know the concepts of dynamics of electrical vehicles
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles(HEVs)
- To understand the concept of energy storage systems.
- To provide knowledge about different energy sources and energy management in HEVs.

Unit I	**HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS**	**9**

History of evolution of Electric Vehicles - Comparison of Electric Vehicles with Internal Combustion Engines - Architecture of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV) – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes – Tamil Nadu Electric Vehicle Policy

Unit II	**MECHANICS OF HYBRID ELECTRIC VEHICLES**	**9**

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV's - motor torque and power rating and battery capacity.

Unit III	**CONTROL OF DC AND AC MOTOR DRIVES**	**9**

Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives

Unit IV	**ENERGY STORAGE SYSTEMS**	**9**

Battery: Principle of operation, types, models, estimation of parameters, battery modeling, SOC of battery, Traction Batteries and their capacity for standard drive cycles, Vehicle to Grid operation of EV's. Alternate sources: Fuel cells, Ultra capacitors, Fly wheels.

Unit V	**HYBRID VEHICLE CONTROL STRATEGY AND ENERGY MANAGEMENT**	**9**

HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode - energy management of HEV's.

Total Periods	**45**

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

CO1: Illustrate the electric vehicle architecture and power train components.

CO2: Illustrate the concepts of electric vehicle dynamics.

CO3: Examine the AC and DC motor drive controls employed in electric vehicles.

CO4: Describe the energy storage systems used in electric vehicles.

CO5: Summarize the mode selection methods and energy management methods in hybrid

electric vehicles.
Text Books:
1. Iqbal Husain, 'Electric and Hybrid Electric Vehicles', CRC Press, 2011.
2. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2015.
References:
1. Wei Liu, 'Hybrid Electric Vehicle System Modeling and Control', Second Edition, Wiley, 2017.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. Iqbal Hussain, "Electric & Hybrid Vechicles – Design Fundamentals", Second Edition, CRC Press, 2011.
4. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												1
2	3	2	3		2								1	2
3	3			2	2	1	1		1		1			2
4	3	2	3	2	2	1	1		1		1		1	2
5	3		3	2	2	1	1		1		1		2	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2822	**DIGITAL CONTROL SYSTEM**	**3**	**0**	**0**	**3**

Objectives:

To impart knowledge about the following topics:

- Importance of digital control and transforms.
- Introduction to MIMO system and its time response.
- Concept of Stability in MIMO systems.
- Design digital PID controllers.
- State space analysis of MIMO systems.

Unit I	**INTRODUCTION**	**9**
Introduction to digital control – Sampling Process – Sample and Hold Circuit – Zero and First Order hold – Z-Transform – Inverse Z- Transform – Region of convergence – Initial and Final Value Theorem		
Unit II	**PULSE TRANSFER FUNCTION AND TIME RESPONSE**	**9**
Block diagram reduction methods – Reduction Rules- Multi-loop – MIMO Systems – Signal		

Flow Graph- steady state error – error transfer functions- Error Constants-Time-Domain Analysis of Second Order Systems-Time Response.		
Unit III	**STABILITY**	**9**
Introduction-Jury Stability Test- Schur-Cohn stability Test- Bilinear transformation- Stability by Pole Location – Root locus method- Bode Plot- Nyquist Plot.		
Unit IV	**DIGITAL PID CONTROLLER**	**9**
Cascade Compensation- Digital Lag Lead Compensator by Bode method- Design of P,PI and PID Controller- Ziegler's- Nichols Method, Cohen-Coon Method.		
Unit V	**STATE SPACE ANALYSIS**	**9**
Realization of Pulse Transfer Function- Diagonalisation- discretization of Continuous time systems, State Transition Matrix- Solution of Discrete-time state equations- Controllability and Observability.		
	Total Periods	**45**

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

CO1: Ability to understand the importance of digital Control

CO2: Ability to solve multi input multi output system MIMO

CO3: Ability to investigate the stability of MIMO system

CO4: Ability to apply advanced control theory to practical engineering problems

Text Books:

1.V.I.George and C.P.Kurien, Digital Control System, Cengage Learning, 2012.

2.B.C.Kuo, Digital Control System, 2nd Edition, Oxford University Press, 2010.

3.M.SamiFadali, Antonio Visioli, Digital Control Engineering Analysis and Design, Academic.

References:

1.M.Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill, 3rd Edition, 2009.

2.C.M. Houpis, G.B.Lamount, ' Digital Control Systems- Theory, Hardware, Software', International Student Edition, McGraw Hill Book Co., 1985.

3.KannanM.Moddgalya, Digital Control, Wiley India, 2007.

4.C.L.Philips and J.M.Pan, "Feedback Control System, Pearson, 2013.

COs	**Pos**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	3										
2	3	3	3	3	3										
3	3	3	3	3	3										
4	3	3	3	3	3				3			3			

Course Code	Course Title	L	T	P	C
UEE2823	**ENERGY MANAGEMENT AND AUDITING**	**3**	**0**	**0**	**3**

Objectives:

To explain the Energy management and auditing process.

- To introduce energy management in electrical system
- To discuss energy management techniques with respect to motor and lightning loads.
- To discuss energy management techniques for buildings.
- To explain energy audit process.

Unit I	**ENERGY MANAGEMENT IN ELECTRICAL SYSTEMS**	**9**

Electricity billing - Power Factor improvements and benefits - transformers - distribution loss in industrial system - Assessment of T&D losses in power systems - Demand side management

Unit II	**ELECTRIC ENERGY MANAGEMENT FOR MOTOR LOADS**	**9**

Effects of Unbalanced Voltages on the Performance of Motors - Determining Electric Motor Operating Loads - Motor Efficiency Management - Motor Performance Management Process

Unit III	**ELECTRIC ENERGY MANAGEMENT FOR LIGHTNING SYSTEMS**	**9**

Basic parameters and terms - light sources and lamp types - Methods of calculating luminance - energy efficient lightning controls - standards and labelling programs

Unit IV	**ENERGY MANAGEMENT IN BUILDINGS**	**9**

Energy conservation building code (ECBC) - Guidelines on heating ventilation, Air conditioning system, water pumping system, Uninterruptible power supply, escalators and elevators - Energy efficiency measures in buildings - Energy performance assessment and energy savings measures of DG sets

Unit V	**ENERGY AUDIT**	**9**

Energy Audit definition - Need for energy audit - Types of energy audit and approach - benchmarking - Bureau of energy efficiency regulation 2008 - energy monitoring and targeting - Energy management information system (EMIS)

Total Periods	**45**

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

CO1: Explain the concept of electricity billing, power factor improvement and demand side management

CO2: Describe the energy performance of Electrical Motors

CO3:Describe the energy performance of Lighting System

CO4:Explain the Energy Conservation building code, Energy Performance assessment and energy saving measures.

CO5: Explain the process of energy audit including energy monitoring and energy management information system

Text Books:
1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Book I - General aspect of energy management and energy audit, Second Edition 2005, By Bureau of Energy Efficiency, Ministry of Power, India.
3. Book III - Energy efficiency in electrical utilities, Second Edition 2005, By Bureau of Energy Efficiency, Ministry of Power, India.
References:
1. Albert Thumann, "Handbook of Energy Audit", Fairmont Press, 2008.
2.Sonal Desai, "Handbook Of Energy Audit", Mc Graw Hill India, 2015.
3. Wayne C. Turner, "Energy management handbook", Fairmont Press; Marcel Dekker, 2004.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2												
2	3	3		2	1									
3	3	3		2	1									
4	3	2		2		2	2							
5	3	2	2		2		3		2	2		1		

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2824	**MICROCONTROLLER BASED SYSTEM DESIGN**	**3**	**0**	**0**	**3**

Objectives:

- To gain knowledge about PIC architecture and its peripheral interfacing techniques
- To understand the significant features of ARM processor, its architectures and its organization

Unit I	**INTRODUCTION TO PIC MICROCONTROLLER**	**9**
Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations		
Unit II	**INTERRUPTS AND TIMER**	**9**
PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers -Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variability strings.		
Unit III	**PERIPHERALS AND INTERFACING**	**9**

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.		
Unit IV	**INTRODUCTION TO ARM PROCESSOR**	**9**
Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems		
Unit V	**ARM ORGANIZATION**	**9**
3- Stage Pipeline ARM Organization– 5Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Explain the modules of PIC architecture		
CO2: Program on PIC to activate interrupt and timer modules.		
CO3: Illustrate the interfacing of peripheral devices with PIC for data communication		
CO4: Explain the significant features and architectural support of ARM processor		
CO5: Elaborate on use of the organization of ARM towards operating systems and embedded applications		
Text Books:		
1.Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.		
2.Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2000.		
References:		
1.Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007		

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2												2	1
2	1		3	3	2								2	
3	1		3	3	2								2	
4	2				3							2	1	1
5	1		2		3							2	1	2

Course Code	Course Title	L	T	P	C
UEE2825	**POWER QUALITY**	**3**	**0**	**0**	**3**

Objectives:

To impart knowledge about the following topics:

- Causes & Mitigation techniques of various PQ events.
- Various Active & Passive power filters.

Unit I	**CHARACTERISATION OF POWER QUALITY**	**9**

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

Unit II	**ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM**	**9**

Single phase sinusoidal, non sinusoidal source supplying linear and nonlinear loads – Three phase Balance system – Three phase unbalanced system – Three phase unbalanced and distorted source supplying non linear loads – Concept of PF – Three phase three wire – Three phase four wire system.

Unit III	**CONVENTIONAL LOAD COMPENSATION METHODS**	**9**

Principle of Load compensation and Voltage regulation – Classical load balancing problem : Open loop balancing – Closed loop balancing, Current balancing – Harmonic reduction and voltage sag reduction – Analysis of unbalance – instantaneous real and reactive powers – Extraction of fundamental sequence component.

Unit IV	**LOAD COMPENSATION USING DSTATCOM**	**9**

Compensating single phase loads – Ideal three phase shunt compensator structure – Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

Unit V	**SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM**	**9**

Rectifier supported Dynamic Voltage Restorer – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified Power Quality Conditioner: Configurations and characteristics.

Total Periods	**45**

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

CO1: Summarize the various power quality issues and power quality standards associated with electric power system

CO2: Analyze single phase and three phase system supplying linear and non linear loads

CO3: Describe the principle of conventional load compensation methods.

CO4: Explain principle of load compensation using DSTATCOM.

CO5: Explain principle of series compensation of power distribution network.

Text Books:
1.ArindamGhosh ―Power Quality Enhancement Using Custom Power Devices‖, Kluwer Academic Publishers, 2002
2.G.T.Heydt, ―Electric Power Quality, Stars in a Circle Publications, 1994(2nd edition)
References:
1. Barry W.Kennedy: Power Quality Primer, McGraw-Hill, New York, 2000
2.Sankaran.C: Power Quality, CRC Press, Washington D.C., 2002
3. Roger C. Dugan, Mark F. McGranaghan and H.WayneBeaty: Electrical Power System Quality, McGraw-Hill, New York, 2nd Edition, 2002
4. Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000
5.Arrillaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley & Sons Ltd., England, 2000

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3													1
2	3	3	2		2			1					2	1
3	3	3	2	2	2		2	1		1		1		1
4	3	2	3	3	2		2	1		1		1	2	1
5	3	2	3	3	2		2	1		1		1	2	1

HONORS DEGREE (Minimum 6 courses)

Specialization title: Artificial Intelligence and Machine Learning for Electrical Systems

Course Code	Course Title	L	T	P	C
UEE2H21	**PRINCIPLES OF ARTIFICIAL INTELLIGENCE**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- Understand the basic concepts of intelligent agents
- Develop general-purpose problem-solving agents, logical reasoning agents, and agents that reason under uncertainty
- Learn about solving problems with various constraints.
- Apply A.I to various application problems.
- Explain learning problem related to a collection of input–output pairs that predicts the output for new inputs.

Unit I	**INTRODUCTION TO AI AND INTELLIGENT AGENTS**	**9**

Introduction to AI – Agents and Environments – Good behavior concept of rationality – nature of environments – structure of agents. goal-based agents, utility-based agents, learning agents Problem solving agents – search algorithms – uninformed search strategies.

Unit II	**SEARCH TECHNIQUES**	**9**

Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search

Unit III	**CONSTRAINT SATISFACTION PROBLEM (CSP) AND GAME THEORY**	**9**

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – Algorithms for planning as state space search.

Unit IV	**LOGICAL AGENTS**	**9**

Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – Algorithms for planning as state space search.

Unit V	**LEARNING**	**9**

Learning from observations: Forms of learning, Inductive learning, learning decision trees, Ensemble learning, support vector machines, Logical formulation of learning, Knowledge in learning, Learning probabilistic models. Learning with hidden variables Reinforcement Learning: Passive reinforcement Learning, Active Reinforcement learning,Generalization in Reinforcement Learning, Application of Reinforcement Learning

Total Periods	**45**

Course Outcomes: Upon successful completion of the course, students will be able to
CO1: Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings
CO2: Choose appropriate algorithms for solving given AI problems
CO3: Explain CSP and game theory approach in AI
CO4: Design and implement logical reasoning agents
CO5: Describe learning problem from a collection of input–output pairs, learn a function that predicts the output for new inputs.
Text Books:
1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition,2015.
2. Nils J. Nilsson, Artificial Intelligence: A New Synthesis (1 ed.), Morgan-Kaufmann, 1998.
References:
1. Elaine Rich, Kevin Knight, & Shivashankar B Nair, Artificial Intelligence, McGraw Hill, 3rd ed.,2017.
2. Introduction to Artificial Intelligence & Expert Systems, Patterson, Pearson, 1st ed. 2015
3. Logic & Prolog Programming, Saroj Kaushik, New Age International, Ist edition, 2002.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	1	2		1							2		
2	3	2	3	2	1							2	3	1
3		2	3	2									2	1
4	2		3	1	3							3		1
5	3	3	2	3	3							3	1	

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2H22	**FUNDAMENTALS OF MACHINE LEARNING**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- Understand the fundamentals of machine learning.
- Expose to linear models.
- Familiarize with basic machine learning algorithms with classification.
- Understand machine learning algorithms with clustering.
- Learn and apply reinforcement learning techniques.

Unit I	**MODELS OF MACHINE LEARNING**	**9**
Components of learning – learning models – geometric models – probabilistic models –		

logical models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization – generalization bound – approximation generalization trade off – bias and variance – learning curve.		
Unit II	**LINEAR MODELS**	**9**
Linear classification – univariate linear regression - bivariate regression – multivariate linear regression – regularized regression – Logistic regression. Naïve Baye's – Discriminant Functions -Probabilistic Generative Models -Probabilistic Discriminative Models – Bayesian Logistic Regression		
Unit III	**SUPERVISED LEARNING**	**9**
Perceptron: – multilayer neural networks – back propagation - learning neural networks structures – S**upport vector machines:** – soft margin SVM – going beyond linearity – generalization and over fitting – regularization – validation. **Decision trees:** Training and Visualizing a Decision Tree - Making Predictions - Estimating Class Probabilities - The CART Training Algorithm - Computational Complexity - Gini Impurity or Entropy -		
Unit IV	**UNSUPERVISED LEARNING**	**9**
Clustering: Introduction, Mixture densities – K-means clustering – clustering around medoids – silhouttes – hierarchical clustering – k-d trees. **Dimensionality Reduction**: – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis.		
Unit V	**REINFORCED LEARNING**	**9**
Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an action utility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1: Understand fundamentals of machine learning.		
CO2: Apply the linear models for tuning parameters.		
CO 3: Understand and explore the machine learning algorithms with classification.		
CO4: Apply machine learning algorithms with clustering and feature extraction.		
CO5: Apply reinforcement learning techniques for various applications.		
Text Books:		
1. EthemAlpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.		
References:		
1. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.		
2. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014		
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.		
4. Ian Good fellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016		
5. Sebastain Raschka, "Python Machine Learning", Packt publishing (open source).		
6. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.		

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3		2		3							3	1	1
2	3	3	2	1	2							2	3	2
3	3		2	1	2			2				3	1	2
4	3		2	1	2								2	2
5	3		2	3	2								1	1

Course Code	Course Title	L	T	P	C
UEE2H23	FUNDAMENTALS OF INFORMATION THEORY	3	0	0	3

Objectives:

The objective of this course is to enable the students to

- To learn fundamentals of random variables
- To learn information units, entropy and entropy rate
- To understand concepts of data compression
- Be familiar with the methods for the generation of these codes and their decoding techniques.
- To apply information theory in the fields of coding, image processing, and machine learning

Unit I	REVIEW OF PROBABILITY THEORY	9

Set theory fundamentals, Review of Probability theory: Probability measure - Conditional Probability, Random variable, Probability Distribution, discrete and continuous, density estimation - histogram - Parzen window using Gaussian Kernel.

Unit II	ENTROPY, RELATIVE ENTROPY AND MUTUAL INFORMATION	9

Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, Chain rules for entropy, Relative entropy and Mutual Information, Markov Chains, Entropy Rate, Functions of Markove's Chain

Unit III	INFORMATION THEORETIC DATA COMPRESSION	9

Examples of Codes, Kraft Inequality, Optimal codes, Bounds on the optimal code length, Kraft inequality for uniquely decodable codes, Huffman codes, Optmality of Huffman Codes, Comtetetive optimality of the shannon’s code, Generation of discrete distribution from fair coins

Unit IV	CHANNEL CAPACITY	9

Examples of Channel Capacity: Noisless Binary Channel, Noisy Channel, Binary Symmetric Channel, Binary erasure channel, Symmetric Channel, Properties of Channel Capacity, Channel coding theorem, Fano’s Inequality, Hamming codes, Source channel separation theorem

Unit V	INFORMATION THEORETIC CLASSIFICATION	9

Adaptive system, Cost function - Mean square error – Least mean square error - Problems of LMS, Entropy as cost function - Minimum error entropy, Decision tree algorithm.

Total Periods	**45**

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

CO1:Apply mathematical tools for Information theory

CO2:Explain and estimate information theory metrics, entropy, and cross entropy.

CO3:Design an application with error control.

CO4:Analyze the channel capacity and optimize the probability of error

CO5:Describe information theoretic Errors

Text Books:

1. Thomas Cover, Joy Thomas, Elements of Information Theory, Wiley Inderscience, 2nd Edition, 2006.

References:

1. David J C MacKay Information theory, Inference and Learning Algorithms, Cambridge University Press, 2005.
2. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Monica Borda, Fundamentals in Information Theory and Coding, Springer, 2011.
4. R C Gonzalez, and R E Woods, Digital Image Processing, Pearson, 2018.
5. Mark Nelson, "Data Compression Book", BPB Publication 1992

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	3	1	2	2							2		
2		2	2	2	2									
3			2		3							1	2	1
4	3	2	1	1	3				2				1	2
5	2	1	3	1	1									

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2H24	**BIG DATA ANALYTICS**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- To understand about big data.
- To learn and use NoSQL big data management.
- To learn map-reduce analytics using Hadoop and related tools.
- To understand the usage of Hadoop related tools for Big Data Analytics

Unit I	**INTRODUCTION TO BIG DATA**	**9**

Classification of digital data, Structured data, semi structured data, unstructured data, characteristics and evolution of Big data, Challenges with Big data, Big data: Volume, Velocity and Variety, Traditional Business Interest Vs Big Data, Data Ware house Environment and Hadoop Environment

Unit II	**BIG DATA ANALYTICS**	**9**

Introduction to Big Data Analytics: In memory analysis, In database processing, Symmetric Muti Processor System, Massively parallel processing, difference between parallel and distributed system open source analytic tools		
Unit III	**NOSQL DATA MANAGEMENT**	**9**
Introduction to NoSQL – aggregate data models – aggregates – key-value and document data models – relationships – graph databases – schemeless databases – materialized views – distribution models – sharding – master-slave replication – peer-peer replication – sharding and replication – consistency – relaxing consistency – version stamps – map-reduce – partitioning and combining – composing map-reduce calculations		
Unit IV	**BASICS OF HADOOP**	**9**
Data format – analysing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file-based data structures.		
Unit V	**HADOOP RELATED TOOLS**	**9**
Hbase – data model and implementations – Hbase clients – Hbase examples – praxis.Cassandra – cassandra data model – cassandra examples – cassandra clients – Hadoop integration. Pig – Grunt – pig data model – Pig Latin – developing and testing Pig Latin scripts. Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation – HiveQL queries.		
	Total Periods	**45**

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

CO1.	Describe big data and use cases from selected business domains.
CO2.	Explain NoSQL big data management.
CO3.	Install, configure, and run Hadoop and HDFS.
CO4.	Perform map-reduce analytics using Hadoop.
CO5.	Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Text Books:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
3. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.

References:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
4. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
5. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
6. Alan Gates, "Programming Pig", O'Reilley, 2011.

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1		2	2		3							1	1	2
2		2	2	3	3							3		
3					3							2		
4		3	2	1	3							1		
5		2	2	3	3							2	2	2

Course Code	Course Title	L	T	P	C
UEE2H25	APPLICATION OF MACHINE LEARNING AND DEEP LEARNING TO POWER SYSTEM PROBLEMS	3	0	0	3

Objectives:

The objective of this course is to enable the students to

- Power System Challenges and Issues
- Machine Learning Methods in Energy Engineering
- Overview of the Application of Machine Learning for Controlling and Planning Power Systems
- Application of Machine Learning for Clustering in Power Systems
- Application of Machine Learning for Forecasting Power System

Unit I	INTRODUCTION	9

Present and Future Challenges – Big data in future Power System Networks – Distributed Generation – Energy Storage Integrity, Decentralization and Smart Contract -Reliability and security problems -ML Applications and its Challenges.

Unit II	MACHINE LEARNING AND POWER SYSTEM PLANNING	9

Structure of Power System Network- GEP, NEP and SEP, Classification of different ML Methods in Power System, Support Vector Machine, Machine Learning Methods: Application, Formulation for a power system, Group method data handling, SVR, GRNN and decision tree, Convolutional Neural Networks

Unit III	MACHINE LEARNING APPLICATION TO CONTROL PROBLEMS OF POWER SYSTEM	9

ML Methods Categorization, Subsystems of a Power System and their control, Evaluation of operating modes of power system using ML methods, Application of ML in evaluating Security and stability of power system, Voltage and transient stability, Power Quality disturbances assessment.

Unit IV	CLUSTERING IN POWER SYSTEM USING MACHINE LEARNING	9

Steps of clustering a dataset of time-series variations, Power system clustering for dynamic equivalencing, Typical test system with 16-machine, 68-bus, Feature extraction methods, Power System Clustering Using Supervised Learning Methods, Artificial Neural Networks, Decision Trees, Power System Clustering Using Unsupervised Learning Methods-Means Clustering Algorithm, Fuzzy C-Means Clustering Algorithm, Subtractive Clustering Algorithm, Support Vector Clustering Algorithm		
Unit V	**MACHINE LEARNING APPLICATION TO LOAD FORECASTING**	**9**
Electrical load forecasting approaches, Overview on load forecasting categories, Challenges in Power Systems Short-, Medium-, and Long-Term Load Forecasting, Performance Assessment of Algorithms		
	Total Periods	**45**

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

CO1. Explain Machine Learning Methods for Energy Engineering

CO2. Choose appropriate algorithms for control and planning of Power System

CO3. Apply Machine Learning algorithms for power system planning

CO4. Apply principles of Clustering in Machine Learning for Power Systems

CO5. Apply Machine Learning techniques for load forecasting in Power System

Text Books:

1. Morteza Nazari-Heris, "Application of Machine Learning and Deep Learning Methods to Power System Problems", Springer, 2022.

References:

1. Denis N. Sidorov, "Machine Learning for Energy Systems",MDPI Books,2020
2. Aanand Kumbhas." A comprehensive review: Machine learning and its application in integrated power system", Elsevier Energy Reports, 2021.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	1	2	2	1	1						2	2	2
2	3	2	3	2	1							2	3	1
3	1	2	3	2	1								2	1
4	2	2	3	1	3							3		1
5	3	3	2	3	3							3	3	3

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2H26	**ARTIFICIAL INTELLIGENCE APPLICATION IN POWER SYSTEMS**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- The emerging area of AI techniques.
- Fuzzy logic systems, artificial neural networks and optimization techniques.

Unit I	**AI TECHNIQUES IN POWER SYSTEMS**	**9**
History and Applications Knowledge based systems, Structure and definitions, Knowledge acquisition, Inference Engine, Basics of Fuzzy Systems, Artificial Neural Networks and Evolutionary Computing		
Unit II	**ARTIFICIAL NEURAL NETWORK**	**9**
Principles, difference between human and machine intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedbackin Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Power System static security assessment problem		
Unit III	**FUZZY LOGIC**	**9**
Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, The alpha cut method, The extension method, Linguistic Descriptions and their Analytical Forms, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences, Fuzzy Implication and Algorithms, Defuzzification Methods, Centre of Area Defuzzification, Centre of Sums Defuzzification, Fuzzy techniques for voltage control.		
Unit IV	**Genetic Algorithms and Evolutionary Programming**	**9**
Introduction, Genetic Algorithms, Procedure of Genetic Algorithms, Genetic Representations, Initilization and Selection, Genetic Operators, Mutation, The Working of Genetic Algorithms, Evolutionary Programming.		
Unit V	**Application of AI in Power Systems**	**9**
Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting		
	Total Periods	**45**

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

CO1: Elucidate the concept of AI techniques and their applications.

CO2: Design neural network controller for security assessment of power system.

CO3: Describe Fuzzy Logic application for real world problems.

CO4: Describe the concepts of Evolutionary Algorithm.

CO5: Describe the application of ANN and Expert system for power system problems.

Text Books:

1. Sivanandam S.N., Deepa S.N., “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.

2. Jacek.M.Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, New Edition, 2012.

References:

1. KOSKO B., "Neural Networks and Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.
2. Zimmerman H.J., "Fuzzy set theory-and its Applications"-Kluwer Academic Publishers, 3rd Edition, 1996.

3. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India, 3rd Edition, 2012.
4. KLIR G.J., FOLGER T.A., “Fuzzy sets, uncertainty and Information”, Prentice-Hall of India Pvt. Ltd., 1993.
5. Goldberg D.E., “Genetic algorithms in Search, Optimization and Machine learning”, Addison Wesley, 1989.

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2		2		3							3	1	1
2	3	2	3	1	2								2	2
3	3	1	2	1	2							2	1	2
4	3		2	1	2								1	1
5	3		2	3	2								1	1

Course Code	Course Title	L	T	P	C
UEE2H27	INTRODUCTION TO AUTONOMOUS MOBILE ROBOTS	3	0	0	3

Objectives:

The objective of this course is to enable the students to

- Compare different robotic systems that navigate independently in complex environments.
- Develop knowledge on basic sensor systems related to state measurements, navigation and localization.
- Study computer vision perception and learn sensors for environment perception.
- Understand mobile robot locomotion, kinematics, probabilistic map based localization.

Unit I	FUNDAMENTALS OF ROBOT TECHNOLOGY	9

Robot Anatomy, Robot drive systems, Robotic sensors, AI and Robotics – key issues for robot locomotion – legged mobile robots – wheeled mobile robots – aerial mobile robots. Practice Exercise

Unit II	MOBILE ROBOT MOTION ANALYSIS AND CONTROL	9

Transformations and Robot Kinematics Kinematic models and constraints – mobile robot maneuverability – mobile robot workspace – advanced kinematics – motion control-Kinematic control-Sensors for mobile robots – computer vision for robots – image processing for robotics – place recognition – range data. Practice Exercise

Unit III	LOCALIZATION OF MOBILE ROBOTS	9

Introduction to localization – noise and aliasing – localization-based navigation – belief representation – map representation – probabilistic map-based localization – autonomous map building. Practice Exercise

Unit IV	ROBOT PLANNING AND NAVIGATION ARCHITECTURE	9

Planning and navigation – planning and reacting – path planning – obstacle avoidance – navigation architectures. Practice Exercise		
Unit V	**ROBOT CELL DESIGN AND ECONOMIC ANALYSIS FOR ROBOTICS**	**9**
Robot cell layouts, Multiple Robot and Machine Interference, Work cell controls and Inter locks, Economic Analysis: Basic data required, Methods of economic analysis.		
	Total Periods	**45**
Course Outcomes: Upon successful completion of the course, students will be able to		
CO1. Understand and analysis algorithmic approaches, compare the mathematical models on various mobile robots.		
CO2. Address several key challenges in localization, and mapping, and find research issues in visual object detection.		
CO3. Develop knowledge on motion planning and navigation schemes for mobile robots		
CO4. Apply and implement path planning and kinematics for mobile robots.		
CO5. Plan and design		
Text Books:		
1. R. Siegwart, I. R. Nourbaksh, and D. Scarramuzza, "Introduction to Autonomous Mobile Robots", Second Edition, MIT Press, 2011.		
References:		
1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.		

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	1	2	2							2	1	1
2	1	2	2	2	2									1
3	1	1	2	1	3							1	1	1
4	3	2	1	1	3				2				1	2
5	3	1	3	1	1									

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2H28	**FUNDAMENTALS OF DEEP LEARNING**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- Explain the mathematical and computational demands of building neural networks.
- Study the concepts of deep learning.
- Introduce dimensionality reduction techniques.
- Apply deep learning techniques for real time applications.

Unit I	**MATHEMATICAL AND COMPUTATIONAL ASPECTS**	**9**

Linear Algebra, Probability and Information Theory, Numerical Computation and Machine Learning Basics		
Unit II	**DEEP NETWORKS**	**9**
Deep Feed-forward networks: Gradient based Learning, Hidden Units, Back propagation and differentiation algorithms, Regularization of Deep Learning: Parameter norm penalties, Dataset augmentation, Multitask learning, Advarsarial training, optimization for training deep models		
Unit III	**CONVOLUTIONAL NETWORKS**	**9**
Convolution, Pooling , variants of the basic convolution function, Structured outputs, Data types, Convolution algorithm, Random or unsupervised features, neuroscientific basis for convolutional networks.		
Unit IV	**SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS**	**9**
Recurrent Neural Networks (RNN), Bidirectional RNN, Long Short-Term Memory (LSTM), GRU; Case Study - Language Modelling, Image Captioning using RNNs.		
Unit V	**DEEP REINFORCEMENT LEARNING**	**9**
Autoencoder, Generative Adversarial Networks, Deep Reinforcement Learning -Policy gradients, hard attention, Q-Learning, Actor-Critic, Case Study – Text-to-Image Synthesis using GAN		
	Total Periods	**45**

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

CO1.	Explain mathematical and computational aspects of neural network
CO2.	Understand the deep networks along with its limitations.
CO3.	Analyze convolutional networks
CO4.	Apply sequence modeling in practice
CO5.	Apply Deep Learning algorithms in practice

Text Books:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

References:

1. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
3. Francois Chollet, "Deep Learning with Python", Manning, 2018.
4. Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, Springer, 2018.
5. Umberto Michelucci, Applied Deep Learning: A Case-Based Approach to Understanding Deep Neural Networks, Apress, 2018.

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	2		3							1	2	2
2		2	2	3	3							1		
3	2				3							1		
4	3	3	2	1	3							1		
5	2	2	2	3	3							1	2	2

Course Code	Course Title	L	T	P	C
UEE2H29	**FOUNDATIONS OF HUMAN-COMPUTER INTERACTION**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- To learn the learn the terminologies of Human Computer Interaction.
- To be familiar with the design technologies for individuals and persons with disabilities.
- To be aware of mobile HCI.
- To learn the guidelines for user interface.

Unit I	**INTRODUCTION TO HCI**	**9**

The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- design of interactive systems- Physical controls sensors and spatial devices

Unit II	**MODELS OF INTERACTION AND DESIGN PROCESS**	**9**

Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process –Elements of WIMP interface, software life cycle – usability engineering – Prototyping in practice – design rationale; Design rules – principles, standards, guidelines, rules; Evaluation Techniques.

Unit III	**MODELS AND THEORIES**	**9**

Cognitive models – Socio-Organizational issues and stake holder requirements – Communication and collaboration models - Hypertext, Multimedia and WWW, User interface management system, Elements of windowing system.

Unit IV	**MOBILE HCI**	**9**

Mobile Ecosystem: Platforms, Application frameworks - Types of Mobile Applications: Widgets, Applications, Games - Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Tools, Mobile 2.0.

Unit V	**DESIGNING WEB INTERFACES**	**9**

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Designing user support system

Total Periods	**45**

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

CO1. Design effective dialog for HCI.

CO2. Design effective HCI for individuals and persons with disabilities.

CO3. Assess the importance of user feedback.

CO4. Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.

CO5. Develop meaningful user interface.

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004.

References:

1. Brian Fling, "Mobile Design and Development", First Edition ,O"Reilly Media Inc., 2009.
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009.
3. Ben Shneiderman, Designing for Effective Human/Computer Interaction, Pearson, 2010.
4. Jenifer Tidwell, Designing Interfaces, Second Edition, O′Reilly publishers, 2011.
5. David Benyon, Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design, Third Edition, Pearson, 2013.

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	1	1	2	2							1	1	1
2	2	1	2	2	2									1
3	2	1		3	3							1	1	1
4		1	1	1	3			2					1	1
5		1	3	1	1									

Course Code	**Course Title**	**L**	**T**	**P**	**C**
UEE2H30	**FUNDAMENTALS OF IMAGE PROCESSING AND ANALYSIS**	**3**	**0**	**0**	**3**

Objectives:

The objective of this course is to enable the students to

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and the applications,
- To appreciate the use of image processing in various applications.

Unit I	**IMAGE PROCESSING FUNDAMENTALS**	**9**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – FileFormats–colourimagesandmodels-ImageOperations– Arithmetic,logical,statisticalandspatialoperations.

Unit II	**IMAGE TRANSFORMS AND MODELS**	**9**

Image Transforms-Discrete and Fast Fourier Transform and Discrete Cosine Transform, Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrainedand Unconstrained restoration models.

Unit III	**IMAGE SEGMENTATION AND MORPHOLOGY**	**9**

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

Unit IV	**IMAGE ANALYSIS AND CLASSIFICATION**	**9**

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

Unit V	**IMAGE REGISTRATION AND VISUALIZATION**	**9**

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

	Total Periods	**45**

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

CO1: Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing

CO2: Be Familiar with the use of MATLAB and its equivalent open-source tools for processing Images

CO3: Critically analyze different approaches to image processing applications

CO4: Explore the possibility of applying Image processing concepts in various

Text Books:

1. Alasdair McAndrew,―Introduction to Digital Image Processing with Matlab‖, Cengage Learning 2011,India

References:

1. AnilJ Jain,―Fundamentals of Digital Image Processing‖,PHI,2006.
2. Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing ‖, CRC – Taylor and Francis, New York, 2006
3. RafaelC.Gonzalez and Richard E.Woods,―Digital Image Processing‖,Third Edition, Pearson Education, 2008, New Delhi
4. S.Sridhar,-Digital Image Processing, Oxford University Press,2011

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	2		3							1		2
2		3			3							1		
3		3	3									1		
4	3	2	2	1	3							1	2	2

OPEN ELECTIVES OFFERED BY OTHER DEPARTMENTS

OPEN ELECTIVE I (SEMESTER VI)

Sl. NO	DEPARTMENT OFFERING	COURSE CODE	COURSE TITLE	L	T	P	C
1	ECE	UEC2041	Foundation Course on Digital Signal Processing	3	0	0	3
2		UEC2042	Introduction to Communication Systems	3	0	0	3
3		UEC2043	Development of Nano Sensors	3	0	0	3
4		UEC2044	Introduction to Internet of Things	3	0	0	3
5		UEC2045	Introduction to Sensors and Actuators	3	0	0	3
6	CSE	UCS2041	Introduction to Data Structures	2	0	2	3
7		UCS2042	Object Oriented Programming Techniques	2	0	2	3
8		UCS2043	Problem Solving and Programming in C	2	0	2	3
9	IT	UIT2041	Introduction To AR and VR	2	0	2	3
10		UIT2042	Databases and Applications Development	2	0	2	3
11		UIT2043	Introduction to Artificial Intelligence	2	0	2	3
12		UIT2044	Introduction to Data Structures and Algorithms	2	0	2	3
13		UIT2045	Introduction to Object-Oriented Programming and Patterns	2	0	2	3
14		UIT2046	Introduction to Data Science	2	0	2	3
15	BME	UBM2041	Principles of Biomedical Instrumentation	3	0	0	3
16		UBM2042	Materials for Biomedical Applications	3	0	0	3
17		UBM2043	Hospital Planning and Waste Management	3	0	0	3
18	Chemical	UCH2041	E-Waste Management	3	0	0	3
19		UCH2042	Nanoscience for Engineers	3	0	0	3
20		UCH2043	Sustainable Development	3	0	0	3
21	Mechanical	UME2041	Six Sigma Data Analysis	2	0	2	3
22		UME2042	Product Engineering	3	0	0	3
23		UME2043	Operations Management	3	0	0	3
24	Civil	UCE2041	Green Building Design	3	0	0	3
25		UCE2042	Sustainable Infrastructure	3	0	0	3
26		UCE2043	Integrated Water Resource Management	3	0	0	3
27		UCE2044	Environmental Impact Assessment	3	0	0	3
28	MBA	PBA2041	Entrepreneurship	3	0	0	3
29		PBA2042	Supply Chain and Logistics	3	0	0	3

			Management				
30		PBA2043	Design Thinking	2	0	2	3
31	Mathematics	UMA2041	Introduction to Linear Algebra	3	0	0	3
32		UMA2042	Numerical Methods for Engineering	3	0	0	3
33	Physics	UPH2041	Optical and Luminescence Characteristics of Materials	3	0	0	3
34		UPH2042	Nanotechnology and Imaging Techniques	3	0	0	3
35		UPH2043	Nuclear Radiation Hazards and Safety Standards	3	0	0	3
36		UPH2044	Crystal Growth and Radiation Detection Measurements	3	0	0	3
37	English	UEN2041	English for Career Needs	3	0	0	3
38		UEN2042	Word Power for Academic Needs	3	0	0	3
39		UEN2043	Writing Skills for University Admission	3	0	0	3

OPEN ELECTIVE II (SEMESTER VIII)

Sl. NO	DEPARTMENT OFFERING	COURSE CODE	Course Title	L	T	P	C
1	ECE	UEC2046	Foundations of Cryptography	3	0	0	3
2		UEC2047	Introduction to Wireless Networks	3	0	0	3
3		UEC2048	Introduction to Microcontrollers	3	0	0	3
4		UEC2049	Consumer Electronics	3	0	0	3
5		UEC2051	Introduction to Bio Electromagnetics	3	0	0	3
6		UEC2052	Machine Learning for Signal and Image Processing	3	0	0	3
7	CSE	UCS2044	Introduction to Big Data Analytics	2	0	2	3
8		UCS2045	Machine Learning Applications	2	0	2	3
9		UCS2046	Web Technology	2	0	2	3
10	IT	UIT2047	Introduction To Cyber Security	2	0	2	3
11		UIT2048	Introduction To Software Engineering	2	0	2	3
12		UIT2049	IoT Architectures and Programming	2	0	2	3
13		UIT2051	Introduction To Deep Learning	2	0	2	3
14		UIT2052	Introduction To Machine Learning	2	0	2	3
15		UIT2053	Web Services and Devops	2	0	2	3
16	BME	UBM2044	Brain Machine Interface	3	0	0	3
17		UBM2045	Biomedical Physics	3	0	0	3
18		UBM2046	Telehealth Technology	3	0	0	3
19	Chemical	UCH2044	Industrial Safety	3	0	0	3
20		UCH2045	Industrial Waste Management and Audit	3	0	0	3
21		UCH2046	Energy Conservation and Audit	3	0	0	3
22	Mechanical	UME2044	Enterprise Resource Planning	3	0	0	3
23		UME2045	Project Management and Planning	3	0	0	3
24		UME2046	Introduction to Industrial Engineering	3	0	0	3
25	Civil	UCE2045	Experimental Techniques and Instrumentation	3	0	0	3
26		UCE2046	Air Pollution and Control Engineering	3	0	0	3
27		UCE2047	Remote Sensing and GIS	3	0	0	3
28		UCE2048	Environmental Geo-Technology	3	0	0	3
29	MBA	PBA2044	Innovation and Creativity	3	0	0	3
30		PBA2045	Intellectual Property Rights	3	0	0	3
31	Physics	UPH2045	Advanced Functional Materials	3	0	0	3
32		UPH2047	Astrophysics	3	0	0	3
33	English	UEN2044	Creative Writing	2	1	0	3
34		UEN2045	Introduction to Children's Literature	2	0	2	3
35	Chemistry	UCY2041	Electrochemical Energy Storage Technology	3	0	0	3