SETHU INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)

Pulloor, Kariapatti – 626 115

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM & SYLLABUS

(I SEMESTER to VIII SEMESTER)

SUBMITTED TO THE ACADEMIC COUNCIL MEETING HELD ON 27.05.2023

CHAIRMAN
BOARD OF STUDIES

CHAIRMAN
ACADEMIC COUNCIL

SETHU INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Department Vision

To achieve Excellence in Education and Research in the field of Electrical and Electronics Engineering and provide knowledge based contribution for the development of economy and society.

Department Mission

- Providing comprehensive and value based education in Electrical and Electronics engineering and related fields to meet intellectual, ethical and career challenges
- Providing state-of- the-art infrastructure and resources to promote teaching-learning and research activities
- Enriching the skills to enhance employability and entrepreneurship
- Strengthening the collaboration with academia, industry and research organizations
- Fostering Research and Development activities leading to innovation and technological growth in the overall ambit of electrical and electronics engineering
- Offering services to the society through education, science and technology through education and technology.

Program Educational Objectives (PEOs)

After few years of graduation our Electrical and Electronics Engineering graduates are expected to:	
PEO I (Core Competency)	Exhibit technical competency in Electrical and Electronics Engineering and related fields
PEO II (Life Long Learning)	Engage in life-long learning for professional development and research
PEO III (Professional and Ethical Skills)	Exhibit effective communication skills, team work and lead their profession with ethics

Program Outcomes

PO No.	**PROGRAM OUTCOMES**
PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, electrical and electronics engineering fundamentals to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex electrical and electronics engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/Development of solutions:** Design and develop electrical and electronic systems that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.
PO4	**Investigation of complex problems:** Investigate and analyze complex electrical and electronics engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions.
PO5	**Modern tool usage:** Select and Apply modern engineering and IT tools for simulation and modeling of electrical and electronic systems.
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 to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9	**Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary 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 engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO No.	**PROGRAM SPECIFIC OUTCOMES**
PSO1	Demonstrate technical competency in the design and analysis of electrical machines.
PSO2	Design and analyze power electronic interfaces for renewable energy systems.

SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti – 626 115

B.E. Degree Programme
CBCS CURRICULUM
Regulations 2019

Bachelor of Engineering in Electrical and Electronics Engineering

OVERALL COURSE STRUCTURE

Category	Total No. of Courses	Credits	Percentage
Humanities and social Sciences(HS)	7	13.5	7.71
Basic Sciences (BSC)	8	23.5	13.43
Engineering Sciences (ESC)	9	25	14.29
Professional Core (PC)	28	68	38.86
Professional Electives (PE)	6	18	10.29
Open Electives (OE)	4	12	6.86
Project Work (PRO)	5	15	8.57
Mandatory Courses (MC)	5	Non - Credit	
TOTAL	72	175	100

COURSE CREDITS – SEMESTER WISE

Semester	I	II	III	IV	V	VI	VII	VIII	TOTAL
Credits	23	20.5	25	23.5	22.5	25.5	21	14	175

Semester I

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UEN101	HS	English for Technical Communication	2	0	0	2
19UMA102	BSC	Engineering Mathematics – I	3	1	0	4
19UPH103	BSC	Engineering Physics	3	0	0	3
19UCY105	BSC	Applied Chemistry *(Common to ECE, EEE, CSE, IT & Biomedical Engineering)*	3	0	0	3
19UCS108	ESC	Problem solving and Python Programming	3	0	0	3
19UME109	ESC	Engineering Graphics	3	1	0	4
Laboratory Courses						
19UGS110	ESC	Problem solving and Python Programming Lab	0	0	3	1.5
19UME111	ESC	Workshop / Engineering Practices Lab	0	0	3	1.5
19UGS113	BSC	Basic Sciences Lab *(Common to all branches)*	0	0	2	1
Mandatory Course						
19UGM131	MC	Induction Programme	45 Periods			NIL
Total Credits						**23**

Semester II

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UEN201	HS	Communication Skills for Professionals *(Common to all branches)*	1	0	1	1.5
19UMA205	BSC	Calculus and Transform Techniques	3	1	0	4
19UPH205	BSC	Physics for Information Science	3	0	0	3
19UCY204	HS	Environmental Science	3	0	0	3
19UEE205	ESC	Introduction to Electrical and Electronics Engineering	3	0	0	3
19UME226	ESC	Basic Civil and Mechanical Engineering	3	0	0	3
Laboratory Courses						
19UGS210	BSC	Energy and Environmental Science Laboratory	0	0	3	1.5
19UEE211	ESC	Introduction to Electrical and Electronics Engineering Laboratory	0	0	3	1.5
Total Credits						**20.5**

Semester III

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UMA324	BSC	Probability, Statistics, Complex Analysis and Numerical Methods	3	1	0	4
19UEE302	PC	Electrical Circuit Analysis	3	1	0	4
19UEE303	PC	Electrical Machines - I	3	0	0	3
19UEE304	PC	Analog Electronics	3	0	0	3
19UEE305	PC	Electromagnetic Fields	3	1	0	4
19UEE306	PC	Electrical Measurements and Instrumentation	3	0	0	3
Laboratory Courses						
19UEE307	PRO	Seminar	0	0	2	1
19UEE308	PC	Electric circuits Laboratory	0	0	2	1
19UEE309	PC	Electrical Machines Laboratory - I	0	0	2	1
19UEE310	PC	Analog Electronics Laboratory	0	0	2	1
Mandatory Courses						
19UGM332	MC	Biology for Engineering Applications	2	0	0	P/F
	Total Credits					**25**

Semester IV

Course Code	category	Course Title	L	T	P	C
Theory Courses						
19UEE401	PC	Electrical Machines - II	3	0	0	3
19UEE402	PC	Control Systems	3	1	0	4
19UEE403	PC	Principles of Digital Electronics	3	1	0	4
19UEE404	PC	Electric Power Transmission and Distribution	3	1	0	4
19UIT426	ESC	Data Structure using C (Integrated Course)	3	0	3	4.5
Laboratory Courses						
19UEE406	PC	Electrical Machines Laboratory - II	0	0	2	1
19UEE407	PC	Control and Instrumentation Laboratory	0	0	2	1
19UEE408	PC	Digital Electronics Laboratory	0	0	2	1
19UGS431	HS	Reasoning and Quantitative Aptitude	0	0	2	1
Mandatory Courses						
19UGM431	MC	Gender Equality	1	0	0	P/F
	Total Credits					**23.5**

Semester V

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UEE501	PC	Power Electronics	3	0	0	3
19UEE502	PC	Internet of Things for Electrical Automation	3	0	0	3
19UEE503	PC	Microprocessor and Microcontroller Programming	3	0	0	3
	PE	Elective - I	3	0	0	3
	PE	Elective - II	3	0	0	3
	OE	Open Elective - I	3	0	0	3
Laboratory Courses						
19UEE507	PRO	Creative Thinking and Innovation	0	0	2	1
19UEE508	PC	Power Electronics Laboratory	0	0	2	1
19UEE509	PC	Microprocessor and Microcontroller Programming Laboratory	0	0	2	1
19UGS532	HS	Soft Skills Laboratory	0	0	3	1.5
Total Credits						**22.5**

Semester VI

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UEE601	PC	Electric Drives and Control	3	0	0	3
19UEE602	PC	Power System Analysis	3	1	0	4
19UEC621	ESC	Digital Signal Processing for Electrical Engineers	3	0	0	3
	PE	Elective - III	3	0	0	3
	PE	Elective - IV	3	0	0	3
	OE	Open Elective - II	3	0	0	3
Laboratory Courses						
19UEE607	PRO	Product Development Project	0	0	8	4
19UEE608	PC	Electric Drives and Control Laboratory	0	0	2	1
19UGS633	HS	Interpersonal Skills Development Laboratory	0	0	3	1.5
Mandatory Courses						
19UGM631	MC	Indian Constitution	1	0	0	P/F
Total Credits						**25.5**

Semester VII

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
19UME701	HS	Project Management and Finance	3	0	0	3
19UEE702	PC	Electric Vehicles	3	0	0	3
19UEE703	PC	Electric Energy Utilization and Conservation	3	0	0	3
19UEE704	PC	Protection and Switch Gear	3	0	0	3
	PE	Elective - V	3	0	0	3
	OE	Open Elective - III	3	0	0	3
Laboratory Courses						
19UEE707	PRO	Summer Internship				1
19UEE708	PC	Power System Simulation Laboratory	0	0	2	1
19UEE709	PC	Renewable Energy Laboratory	0	0	2	1
Mandatory Courses						
19UGM731	MC	Professional Ethics and Human Values	2	0	0	P/F
Total Credits						**21**

Semester VIII

Course Code	Category	Course Title	L	T	P	C
Theory Courses						
	PE	Elective - VI	3	0	0	3
	OE	Open Elective - IV	3	0	0	3
Laboratory Courses						
19UEE803	PRO	Project Work	0	0	16	8
Total Credits						**14**

LIST OF PROFESSIONAL ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1.	19UEE901	Network Analysis and Synthesis	3	0	0	3
2.	19UEE902	High Voltage Engineering	3	0	0	3
3.	19UEE903	Design of Electrical Machines	3	0	0	3
4.	19UEE904	Special Electrical Machines	3	0	0	3
5.	19UEE905	Power Quality	3	0	0	3
6.	19UEE906	Fundamentals of FACTS	3	0	0	3
7.	19UEE907	HVDC Transmission	3	0	0	3
8.	19UEE908	EHV AC and DC Transmission	3	0	0	3
9.	19UEE909	Energy Audit	3	0	0	3
10.	19UEE910	Electrical Equipment's Erection and Commissioning	3	0	0	3
11.	19UEE911	Electrical Safety	3	0	0	3
12.	19UEE912	Robotics and Automation	3	0	0	3
13.	19UEE913	Solar and Wind Energy Systems	3	0	0	3
14.	19UEE914	Power System Restructuring	3	0	0	3
15.	19UEE915	Application of Power Electronics to Power Systems	3	0	0	3
16.	19UEE916	Modern optimization techniques for Electric Power Systems	3	0	0	3
17.	19UEE917	Non-Linear Control Systems	3	0	0	3
18.	19UEE918	Digital Control Systems	3	0	0	3
19.	19UEE919	Design with PIC Microcontrollers	3	0	0	3
20.	19UEE920	Machine Learning	3	0	0	3
21.	19UEE921	Fuzzy systems and Genetic Algorithms	3	0	0	3
22.	19UEE922	Sensing Techniques and Sensor Systems	3	0	0	3
23.	19UEE923	Introduction to Micro Electro Mechanical Systems	3	0	0	3
24.	19UEE924	Computer Aided Design of Electrical Apparatus	3	0	0	3
25.	19UEE925	Intelligent Motor Controllers	3	0	0	3
26.	19UEE926	Energy Efficient Motors	3	0	0	3
27.	19UEE927	Advanced Microprocessor and Microcontroller	3	0	0	3
28.	19UEE928	Consumer Electronics	3	0	0	3
29.	19UEE929	PCB Design (Integrated Course)	2	0	2	3
30.	19UEE930	PLC and SCADA Applications (Integrated Course)	2	0	2	3
31.	19UEE931	Analog and Mixed Mode VLSI Design	3	0	0	3
32.	19UEE932	Smart Grid	3	0	0	3
33.	19UEE933	Power System Operation and Control	3	0	0	3
34.	19UEC959	Principles of Communication	3	0	0	3
35.	19UEC960	Fiber Optic Communication	3	0	0	3
36.	19UPH955	Fundamentals of Nano Science	3	0	0	3

LIST OF OPEN ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C
1	19UEE971	Non-Conventional Energy Resources and Applications	3	0	0	3
2	19UEE972	Electric and Hybrid Vehicles	3	0	0	3
3	19UEE973	Solar Power Plants	3	0	0	3
4	19UEE974	MEMS	3	0	0	3
5	19UEE975	Principles of Robotics	3	0	0	3
6	19UEE976	Applied Soft Computing	3	0	0	3

LIST OF MANDATORY COURSES

S.No.	Course Code	Course Title	L	T	P	C
1	19UGM131	Induction Programme	45 hours			P/F
2	19UGM332	Biology for Engineering Applications	2	0	0	P/F
3	19UGM431	Gender Equality	1	0	0	P/F
4	19UGM631	Indian Constitution	1	0	0	P/F
5	19UGM731	Professional Ethics and Human Values	2	0	0	P/F

LIST OF INTERDISCIPLINARY COURSES

Sl. No.	Course Code	Course Title	L	T	P	C
1	19UGM954	Smart Buildings (Common to EEE & Civil)	3	0	0	3
2	19UGM955	Electric Vehicles (Common to EEE & Mech.)	3	0	0	3
3	19UGM956	Electrical Hazards & Safety In Hospitals (Common to EEE & BME)	3	0	0	3

LIST OF INDUSTRY DESIGNED COURSES

Sl. No.	Course Code	Course Title	L	T	P	C
1	19UEE861	Wind farm Development and Operation	1	0	0	1
2	19UEE862	Design of Towers and Blades Structures	1	0	0	1
3	19UEE863	Wind Turbine Blades Fabrication Technology	1	0	0	1
4	19UEE864	Solar Photovoltaic Technology	1	0	0	1
5	19UEE865	Industrial safety measures	1	0	0	1
6	19UEE866	ECO Paint Application Technology for Automobile Industry	1	0	0	1
7	19UEE867	Energy Storage Systems	1	0	0	1
8	19UEE868	Controlling and Monitoring of Electrical Equipments using Mobile Applications	1	0	0	1
9	19UEE869	Electrical Rewinding Laboratory	0	0	2	1

19UEN101	ENGLISH FOR TECHNICAL COMMUNICATION	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To enhance the vocabulary of students
- To strengthen the application of functional grammar and basic skills
- To improve the language proficiency of students

UNIT I **8**

Listening –Formal and informal conversations and comprehension Speaking- introducing oneself – exchanging personal and social information- Reading – Skimming and Scanning. Writing – Sentence Formation, Formal Letters (Permission/Requisition) - Grammar - Parts of Speech - Tense - Vocabulary Development – Technical Word Formation- Prefix- suffix - Synonyms and Antonyms-Phrases and Clauses.

UNIT II **8**

Listening– Telephonic Conversations. Speaking – Pronunciation rules with Stress pattern. Reading – comprehension-pre-reading, post-reading- comprehension questions Writing – Punctuation rules, paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions, Precise writing, Developing Hints - Report Writing (Industrial, Accident) - Grammar – Voice Vocabulary Development- Words from other languages in English.

UNIT III **7**

Listening – Motivational speech by Great Speakers Speaking –Narrating daily events -retelling short stories. Reading – Newspaper reading. Writing – Job application letter - Transformation of Information (Transcoding) –Grammar Subject-Verb Agreement (Concord),— Vocabulary Development –Same word in different parts of speech

UNIT IV **7**

Listening – Understating the instruction. Speaking -Intonation and preparing dialogue on various formal and informal situation Reading –Note Making from given text - Writing –Creating coherence, Essay writing with proper introduction and conclusion, Giving Instruction (Guidance/Procedure) - Grammar – Spot the Errors in English, Vocabulary Development – One word substitution.

Total: 30 Periods

TEXT BOOKS:

1. KN Shoba, Lourdes Joavani Rayen, Communicative English, New Delhi, Cambridge University Press, 2017.

REFERENCE BOOKS:

1. Raman, Meenakshi, Sangeetha Sharma, Business Communication, New Delhi, Oxford University Press, 2014.
2. Lakshminarayanan. K.R, English for Technical Communication, Chennai, Scitech Publications (India) Pvt. Ltd, 2004.
3. Rizvi. Asraf M, Effective Technical Communication, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2007.

COURSE OUTCOMES:

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

- Apply grammar effectively in writing meaningful sentences and paragraphs.
- Exhibit reading skills and comprehension to express the ideas in the given text.
- Develop writing skills to present the ideas in various formal situations.
- Develop oral fluency to express the ideas in various formal situations.
- Exhibit writing skills to prepare reports for various purposes.

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3				
CO2									2	3				
CO3									2	3				
CO4									2	3				
CO5									2	3				
CO6									2	3				

19UMA102	ENGINEERING MATHEMATICS – I	L	T	P	C
	(Common to ALL Branches – Except CSBS)	3	1	0	4

COURSE OBJECTIVES:

- To make the students capable of identifying linear equations based problems (Eigen Value) from practical areas and obtain the Eigen value oriented solutions in certain cases.
- To widen the students' knowledge base on linear algebra, growth rate computation and application of integrals.
- Able to integrating various types of functions using various integration methods.
- To familiarize the students with the basic rules of differentiation and use them to find derivatives of products and quotients of functions
- To apply these mathematical concepts (matrix theory, differentiation and integration) in engineering field.

UNIT I MATRICES 8+3

Eigen value and eigenvector of a real matrix – Characteristic equation – Properties – Cayley-Hamilton theorem (excluding Proof) – Orthogonal reduction –(transformation of a symmetric matrix to diagonal form) – Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 9+3

Introduction – Definition of derivatives – Limits and Continuity – Differentiation techniques (Product rule, Quotient rule, Chain rule) – Successive differentiation (n^{th} derivatives) – Leibnitz theorem (without proof) – Maclaurin's series – Physical Applications (Newton's law of cooling – Heat flow problems, Rate of decay of radioactive materials - Chemical reactions and solutions, Ohm's law, Kirchoff's law – Simple electric circuit problems).

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Differentiation of implicit functions – Jacobian – Taylor's expansion – Maxima and Minima – Method of Lagrangian Multipliers.

UNIT IV INTEGRAL CALCULUS 8+3

Definitions and concepts of integrals – Methods of integration (Decomposition method, Substitution method, Integration by parts) – Definite integrals – Properties and problems – Reduction formulae – Beta and Gamma functions.

UNIT V MULTIPLE INTEGRALS 8+3

Double integration – Cartesian and Polar coordinates – Change of order of integration – Area as a double integral - Change of variables between Cartesian and Polar coordinates – Triple integration in Cartesian coordinates – Volume as triple integral.

SUPPLEMENT TOPIC (for internal evaluation only) 3

Evocation /Application of Mathematics, Quick Mathematics – Speed Multiplication and Division Applications of Matrices.

Total: 45 (L) + 15 (T) = 60 Periods

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Laxmi Publications (P) Ltd, New Delhi, 8th Edition, (2011).
2. Veerarajan.T "Engineering Mathematics" Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 42nd Edition, (2012).

REFERENCE BOOKS:

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. Glyn James, "Advanced Engineering Mathematics", Pearson Education, New Delhi, 7th Edition, (2007).
3. Jain R.K and Iyengar S.R.K," Advanced Engineering Mathematics", Narosa Publishing House, New Delhi, 3rd Edition, (2007).
4. Bharati Krishna Tirthaji, "Vedic Mathematics - Mental Calculation", Motilal Banarsi Dass Publications, New Delhi, 1st Edition, (1965).
5. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley & Sons, New York, 10th Edition, (2011).
6. P.Sivaramakrishna Das, E.Rukmangadachari"Engineering mathematics", volume1, Pearson Edison New Delhi, 2nd Edition, (2013).

COURSE OUTCOMES:

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

- Apply the Characteristic Equation, Characteristic roots and use the applicability of Cayley – Hamilton theorem to find the Inverse of matrix. (CO1) Apply – K3.

- Analyze functions using limits, continuity, derivatives and to solve Physical application problems.(CO2) Analyze – K4
- Apply differentiation techniques and Lagrange multiplier method to predict the extreme values of the functions with constrain.(CO3) Apply – K3
- Apply the concept of some special function like Gamma, Beta function and their relation to evaluate some definite integral.(CO4) Apply – K3
- Apply integration to compute Multiple integrals, Area and Volume in addition to change of order and change of variables.(CO5) Apply – K3
- Understand the basic concept in Matrix, Differentiation and Integration. (CO6) Understand – K2

CO –PO MAPPING

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3			1								1	2	
CO2	3	3		1								1	2	
CO3	3			1								1	2	
CO4	3			1								1	2	
CO5	3			1								1	2	
CO6	3			1								1	2	

19UPH103	ENGINEERING PHYSICS (Common To All Branches)	L 3	T 0	P 0	C 3

COURSE OBJECTIVES:

- To develop the research interest in crystal physics
- To use the principles of Lasers and its types
- To apply principles of Quantum physics in engineering field
- To develop knowledge on properties of materials

UNIT I CRYSTAL STRUCTURE 12

Introduction – Classification of solids –Space lattice –Basis-Lattice parameter – Unit cell – Crystal system –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 – crystal imperfection –Point defects-Line defects-Surface defects-Volume defects Burger vector.

UNIT II PHOTONICS 10

Introduction- Principles of Laser- Characteristics of laser -Spontaneous and stimulated emission –Population inversion – Einstein's A and B coefficients - Pumping methods – Basic components of Laser - Types of lasers – Nd -YAG laser - CO2 laser –Holography – Construction and Reconstruction of hologram – Industrial and Medical Applications.

UNIT III QUANTUM MECHANICS 13

Introduction - Black body radiation – Planck's law of radiation- Wien's displacement law- Rayleigh Jeans law- – Compton Effect – Theory and experimental verification – Matter waves - Schrodinger's wave equation – Time dependent – Time independent equation – Particle in 1-D dimensional box.

UNIT IV PROPERTIES OF SOLIDS 10

Introduction - Elasticity- Stress and Strain - Hooke's law – Three moduli of elasticity –stress-strain curve – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending –I- shaped girders.

Total: 45 Periods

TEXT BOOKS:

1. Dr. Mani.P, "Engineering Physics", Dhanam Publications, Edition ,2018, Chennai.
2. Rajendran.V, "Engineering,Physics", Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition 2018.

COURSE OUTCOMES:

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

- Classify the types of crystals, lasers, elasticity and quantum behavior of solids [Understand]
- Apply the basic knowledge of crystal, quantum mechanics and mechanical behavior of solids to solve engineering problems [Apply]
- Apply the principle of laser to estimate the wavelength of emitted photons. [Apply]
- Analyze the dual nature of matter using the concepts of quantum mechanics [Analyze]
- Analyze the structural and optical properties of crystals in industrial and medical applications [Analyze]
- Analyze the properties of materials for specific Engineering Applications. [Analyze]

CO –PO MAPPING

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2											2	2	
CO2	3	2										2		
CO3	3	2										2	2	
CO4	2	3										2	2	
CO5	2	3										2		
CO6	2	3							2			2	2	

19UCY105	APPLIED CHEMISTRY	L	T	P	C
	(Common to EEE, ECE, CSE,IT, BME & IT)	3	0	0	3

COURSE OBJECTIVES:

- To gain the knowledge on Chemical bonding and types.
- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To know the importance of smart material and green chemistry.
- To acquire knowledge on energy storage devices.

UNIT I CHEMICAL BONDING 11

Chemical Bonding: Electronic Configuration– Ionic Bond - Covalent Bond – Metallic bond – Aufbau principle, Pauli Exclusion principle, Valence bond theory application and its limitations, Various types of hybridization (sp, sp^2,sp^3) (C_2H_2, C_2H_4, CH_4) -bond strength and bond energy - Hydrogen bonding, Vander Waals forces.

UNIT II WATER AND ITS TREATMENT TECHNOLOGIES 11

Hardness of water – types – expression of hardness (Problems) – units – estimation of hardness of water by EDTA – boiler troubles (scale and sludge) – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment Ion exchange process - zeolite process – desalination of brackish water – Reverse Osmosis.

UNIT III SMART MATERIALS AND GREEN CHEMISTRY 11

Introduction to smart materials and their structure - Organic Light Emitting Diodes – Principles and applications, Liquid crystals – definition and applications. Green chemistry – Concept, importance, principles – e- waste disposal.

UNIT IV ENERGY STORAGE DEVICES 12

Batteries, fuel cells and super capacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2 - O_2 fuel cell and application.

Total: 45 Periods

TEXT BOOKS:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2002.
2. Dr.Sunita Rattan, “A Textbook of Engineering Chemistry” S.K.Kataria & Sons., New Delhi, 2013.

REFERENCE BOOKS:

1. Derek Pletcher and Frank C. Walsh, “Industrial Electrochemistry”, Chapman and Hall, New York, 1993.
2. Peter Grundler, “ Chemical Sensors – An introduction for Scientists and Engineers”, Springer, New York, 2007.

COURSE OUTCOMES:

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

- Describe the basic concept of chemistry involved in chemical bonding, water treatment methods, smart materials, e-waste management and energy storage devices. [Understand]
- Apply the knowledge of chemical bonding to identify the types of bonds in molecules. [Apply]
- Analyze the impurities of water to find its hardness and remove the hardness causing substances. [Analyze]
- Explain the principles and application of organic light emitting diodes, liquid crystals and green chemistry [Understand]
- Apply the knowledge of the basic electrochemical cell terminology to differentiate various types of energy storage devices. [Apply]

CO –PO MAPPING

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1				2	3					1		1
CO2	2	2												
CO3	3	3				2						1		
CO4	2	1				2	2					1		
CO5	3	2				2	2					1		1

19UCS108	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to ALL Branches)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the concepts in problem solving for computing
- To familiarize the logical constructs of programming
- To illustrate programming in Python.

UNIT I INTRODUCTION 9

Definition and basic organization of computers – classification of computers – Software – Types of software – types of programming paradigms - Translators: compiler and interpreter – Problem solving tools: Algorithms – Flowchart – Pseudo code.

UNIT II INTRODUCTION TO PYTHON 9

Introduction to python – features of python – modes of working with python. Values and data types: numbers, Boolean, strings; variables, expressions, statements, tuple assignment, precedence of operators, comments – print function- conversion of algorithm in to program – Solving simple problems involving arithmetic computations and sequential logic to solve.

UNIT III CONTROL CONSTRUCTS 9

Flow of execution – control structures: conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass – Solving problems involving decision making and iterations.

UNIT IV FUNCTIONS AND PACKAGES 9

Functions - function definition and use, flow of execution, parameters and arguments; parameters, local and global scope, function composition-Anonymous or Lambda Function, recursion -packages.

UNIT V LISTS, TUPLES, DICTIONARIES AND STRINGS 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension - Strings: string slices; immutability, string functions and methods, string module.

Total: 45 Periods

TEXT BOOKS:

1. Ashok Namdev Kamthane& Amit Ashok Kamthane, “Problem solving and python programming”, McGraw Hill Education, 2018 (copyright)
2. Anurag Gupta & G P Biswas, “Python Programming – Problem solving, packages and

libraries", McGraw Hill Education, 2020 (copyright).

REFERENCE BOOKS:

1. John V Guttag, " Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python||, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs, Cengage Learning, 2012.
5. Charles Dierbach, " Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC, 2013.

COURSE OUTCOMES:

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

- Utilize problem solving tools in solving computing problems. [Apply]
- Solve mathematical expressions involving sequential logic in python.[Apply]
- Solve problems using python using decision structure and looping constructs.[Apply]
- Write modular programs using functions and packages. [Apply]
- Manipulate data using List, Tuples, Dictionaries and strings.[Apply]

CO – PO MAPPING

CO	POs											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	3	3	2						2		
CO2	3	3	2	2								
CO3	3	3	3	2								
CO4	3	3	3	3								
CO5	3	3	3	2								

19UME109	ENGINEERING GRAPHICS	L	T	P	C
	(Common to ALL Branches)	3	1	0	4

COURSE OBJECTIVES:

- To develop student's graphic skill for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.
- To impart knowledge in development of surfaces, isometric and perspective projections.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 4

Importance of Graphics in Engineering Applications – Use of Drafting Instruments – BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets – Lettering and Dimensioning-Introduction to Plane Curves, Projection of Points, Lines and Plane Surfaces.

UNIT I PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder and cone with axis is parallel, perpendicular and inclined to one of the plane.

UNIT II SECTION OF SOLIDS 10

Section of solids - simple position with cutting plane parallel, perpendicular and inclined to one of the plane.

UNIT III DEVELOPMENT OF SURFACES 10

Development of lateral surfaces of simple and truncated solids - Prisms, pyramids and cylinders and cones - Development of lateral surfaces of sectioned solids.

UNIT IV ISOMETRIC PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric view - isometric projections of simple solids and cut solids.

UNIT V ORTHOGRAPHIC PROJECTION 12

Representation of Three Dimensional objects – General principles of orthographic projection-Need for importance of multiple views and their placement – First angle projection – layout views – layout views – Developing visualization skills of multiple views (Front, top and side views) from pictorial views of objects.

Total: 45 (L) + 15 (T) = 60 PERIODS

TEXT BOOKS:

1. Natarajan K.V., “A Text book of Engineering Graphics”, Dhanalakshmi Publishers, (2006).
2. Bhatt N.D., “Engineering Drawing”, 46th Edition, Charotar Publishing House,(2003).

REFERENCE BOOKS:

1. Venugopal K., and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited,(2008).
2. Gopalakrishnan K.R., “Engineering Drawing” (Vol.I&II), Subhas Publications.(1998).
3. DhananjayA.Jolhe, “Engineering Drawing with an introduction to Auto CAD”, Tata McGraw Hill Publishing Company Limited,(2008).

COURSE OUTCOMES:

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

- Draw orthographic projections of basic geometrical entities in various positions and translate the Geometric information of engineering objects into engineering drawings. [Understand]
- Apply the principles of orthographic projections to draw projections of solids and sectionsof solids. [Apply]
- Develop lateral surfaces of regular and sectioned solids. [Apply]
- Prepare isometric drawings of simple solids from orthographic views. [Apply]
- Construct orthographic projection from the given pictorial view. [Apply]
- Analyze the projections of various solid models using different resting conditions. [Analyze]

CO – PO MAPPING

CO	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3									3				
CO3	3									3			3	
CO4	3									3			3	
CO5	3									3			3	
CO6	3	2			3					3			3	

		L	T	P	C
19UCS110	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY (Common to ALL Branches)**	0	0	3	1.5

COURSE OBJECTIVES:

- To familiarize with programming environment
- To familiarize the implementation of programs in Python

LIST OF EXPERIMENTS

Problems involve Sequential logic and Decision making

1. Write a Python program to process the mark processing system (Record has the following fields: Name, Reg_no, Mark1, Mark2, Mark3, Mark4, Total, average). Print the student details and find the total and average mark.
2. Write a Python program to compute the +2 Cutoff mark, given the Mathematics, physics and Chemistry marks. A college has decided to admit the students with a cut off marks of180. Decide whether the student is eligible to get an admission in that college or not.
3. A pizza in a circular shape with 8 inches and which is placed in a square box whose side length is 10 inches. Find how much of the box is “empty”?
4. A person owns an air conditioned sleeper bus with 35 seating capacity that routes between Chennai to Bangalore. He wishes to calculate whether the bus is running in profit or loss state based on the following scenario:
   Amount he spent for a day for diesel filling is: Rs. 15,000
   Amount he spent for a day for Driver and cleaner beta is: Rs. 3,000
   Ticket amount for a Single person is Rs: 950
   If all the seats are filled, what would be the result?
   If only 15 seats are filled, what would be the result?
5. Consider the person ‘X’ has some amount in his hand and the person ‘Y’ has some amount in his hand. If they wish to exchange the amount among them, how they can exchange the amount by using the third party ‘Z’.

Problems involve iterations

6. A man is blessed with a duck that can lay golden eggs. First day it lays one egg, in second day it lays two eggs, in third day it lays three eggs, and it continues to lay eggs in an incremental manner day by day. Now calculate how many golden eggs that duck lays till ‘n’th day.
7. Four People A,B,C,D are sitting in a Circular arrangement. In how many ways their seating can be arranged.

8. The Greek theater shown at the right has 30 seats in the first row of the center section. Each row behind the first row gains two additional seats. How many seats are in the 5^{th} row in the center section?

Problem involve functions and recursive functions

9. Write a program that accepts the lengths of three sides of a triangle as inputs. The program output should indicate whether or not the triangle is a right triangle. (Recall from the Pythagoras theorem that in a right triangle, the square of one side equals the sum of the squares of other two sides)
10. A game has to be made from marbles of five colors, yellow, blue, green, red and Violet where five marbles has to be kept one upon another. Write a python program using recursion, to find how many ways these marbles can be arranged.
11. Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:

    Here is a high-level outline of how to move a tower from the starting pole, to the goal pole, using an intermediate pole:

    Move a tower of height-1 to an intermediate pole, using the final pole.

    Move the remaining disk to the final pole.

    Move the tower of height-1 from the intermediate pole to the final pole using original pole

Problems involve List and Nested List

12. In a class of 50 numbers of students, 6 students are selected for state cricket academy. Sports faculty of this school has to report to the state cricket academy about the selected students' physical fitness. Here is one of the physical measures of the selected students'; Height in cm is given for those 6 selected students [153,162,148,167,175,151]. By implementing functions, do the following operations.
    i. State academy selector has to check whether the given height is present in the selected students list or not.
    ii. State academy selector has to order the height of students in an incremental manner.
    iii. State academy selector has to identify the maximum height from the list.

Problems involve Dictionary and Tuples

Dictionary

13. A university wishes to create and maintain the details of the students such as Rollno, Regno, Name, Dept, Batch, Contact_no, Nativity(Indian/NRI) as key value pairs. Do the

following operations:

i. Display the complete student details on giving Rollno as input.
ii. Display the complete student details whose nativity belongs to NRI.
iii. Display the complete student details whose department is CSE.

Tuples

14. A librarian wishes to maintain books details such as ISBN, Book Name, Author Name, Year published, Publisher Name. He wishes to retrieve the book details in the following scenario:

(i) Retrieve the complete details of the book on giving ISBN.
(ii) Retrieve the details of the book which published after the year 2015.
(iii) Retrieve the details of the book whose author name is 'Andrew'.
(iv) Retrieve the details of the book that name of the book is 'Python'

Problems involve Strings

15. A musical album company has 'n' number of musical albums. The PRO of this company wishes to do following operations based on some scenarios:

(i) Name of the album starts with 's' or 'S'.
(ii) Name of the album which contains 'jay' as substring.
(iii) Check whether the album name presents in the repository or not.
(iv)Count number of vowels and consonants in the given album name.

Total: 45 Periods

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

- Formulate algorithms for simple problems and translate the algorithms to a working program. [Apply]
- Formulate algorithms and programs for arithmetic computations and sequential logic.[Apply]
- Write iterative programs using control constructs.[Apply]
- Develop programs using functions, packages and use recursion to reduce redundancy.[Apply]
- Represent data using lists, tuples, dictionaries and manipulate them through a program.[Apply]

HARDWARE / SOFTWARE REQUIRED FOR A BATCH OF 30 STUDENTS

Hardware

LAN System with 30 nodes (OR) Standalone PCs – 30 Nos

Software

OS – UNIX Clone (License free Linux)

Editor – IDLE

CO – PO MAPPING

CO	**POs**											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	2											
CO3	2				2							
CO4	3	2			2							
CO5	3	2			2							

		L	T	P	C
19UME111	**ENGINEERING PRACTICES LABORATORY (Common to Mech, EEE, Civil, Chemical and Agriculture)**	0	0	3	1.5

COURSE OBJECTIVES:

- To demonstrate the plumbing and carpentry works.
- To train the students to perform welding, fitting and drilling operations.
- To demonstrate residential house wiring, fluorescent lamp wiring, measurement of earth resistance, colour coding of resistors, logic gates and soldering.

GROUP A (CIVIL & MECHANICAL)

CIVIL ENGINEERING PRACTICE - LIST OF EXPERIMENTS

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

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

3) Hands-on-exercise: Basic pipe connections–Mixed pipe material connection Pipe connections with different joining components.

4) Demonstration of plumbing requirements of high-rise buildings.

5) Study of the joints in roofs, doors, windows and furniture.

6) Hands-on-exercise: Wood work, cutting, planning and joints by sawing –Half lap joint

MECHANICAL ENGINEERING PRACTICE - LIST OF EXPERIMENTS

1) Preparation of arc welding of butt joints, lap joints and tee joints.

2) Drilling Practice.

3) Sheet metal model making – Trays, funnels, etc.

4) Different type of fittings-'V' type, 'L' Type

5) Study of Lathe Machine tool.

6) Study of Plastic Injection Moulding.

7) Study of Moulding.

A minimum of five experiments shall be offered in GROUP A (CIVIL & MECHANICAL)

GROUP B (ELECTRICAL & ELECTRONICS)

ELECTRICAL ENGINEERING PRACTICE - LIST OF EXPERIMENTS

(a) Residential house wiring using switches, fuse, indicator, lamp and energy meter and Stair case wiring.

(b) Fluorescent lamp wiring.

(c) Measurement of resistance to earth of electrical equipment.

ELECTRONICS ENGINEERING PRACTICE - LIST OF EXPERIMENTS

(a) Study of Electronic components and equipments – Resistor, colour coding

Measurement of AC Signal parameter (peak-peak, rms, period, frequency) using CRO.

(b) Study of logic gates AND, OR, EX-OR and NOT Gate.

(c) Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

Total: 45 Periods

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

- Illustrate the centrifugal pump, air conditioner, lathe machine tool, molding, operations of foundry and fittings. [Understand]
- Demonstrate the carpentry work and plumping work for a given diagram to complete the work. [Apply]
- Select suitable tools for fabrication of sheet metals like cone, funnel and tray. [Apply]
- Practice the welding and drilling operations for the various structures. [Apply]
- Manipulate the components, Logic gates, soldering practices with help of printed circuitboards (PCB). [Understand]
- Operate the various electronic components and using that for the industrial and housingapplication [Apply]

CO – PO MAPPING

CO	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3							3	3				3	
CO2	3							3	3		3		3	
CO3	3							3	3		3		3	
CO4	3							3	3		3		3	
CO5	3							3	3		3		3	
CO6	3							3	3		3		3	

19UGS113	BASIC SCIENCES LAB	L	T	P	C
	(Common to all branches)	0	0	2	1

COURSE OBJECTIVES:

- To create scientific Temper among the students.
- To know how to execute experiments properly, presentation of observations and arrival of conclusions.
- To view and realize the theoretical knowledge acquired by the students through experiments.
- To impart knowledge on basic concepts in applications of chemical analysis
- Train the students to handle various instruments.
- To acquire knowledge on the chemical analysis of various metal ions.

PHYSICS LABORATORY

LIST OF EXPERIMENTS

1. Laser – Determination of particle size and wavelength of Laser source using Diode Laser.
2. Ultrasonic Interferometer - Determination of velocity of sound in liquid and compressibility of liquid.
3. Poiseuille's method - Determination of Coefficient of viscosity of liquid.
4. Spectrometer – Determination of dispersive power of a prism.
5. Air Wedge method - Determination of thickness of a thin wire.
6. Uniform bending method – Determination of Young's modulus of the given rectangular beam.

A minimum of FIVE experiments shall be offered

Laboratory classes on alternate weeks for Physics and Chemistry

CHEMISTRY LABORATORY

LIST OF EXPERIMENTS

1. Preparation of molar and normal solutions of the following substances – Oxalic acid , Sodium Carbonate , Sodium Hydroxide and Hydrochloric acid
2. Conductometric Titration of strong acid with strong base
3. Conductometric Titration of Mixture of Acids
4. Estimation of Iron by potentiometry

5. Determination of Strength of given acid using pH metry
6. Determination of molecular weight of polymer by viscometry
7. Comparison of the electrical conductivity of two samples-conductometric method
8. Estimation of copper in brass by EDTA method

A minimum of FIVE experiments shall be offered

Laboratory classes on alternate weeks for Physics and Chemistry

Total: 30 Periods

COURSE OUTCOMES:

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

- Apply the principles of Optics, Laser physics and Mechanics to determine the Engineering properties of material. [Apply]
- Analyze the given liquid sample to determine the viscosity and compressibility of the liquid. [Analyze]
- Apply the principles of spectroscopy to determine the properties using prism. [Apply]
- Apply the knowledge of Molarity and Normality to prepare standard solution for chemical analysis. [Apply]
- Analyze the concentration of a given analyse by analytical methods. [Analyze]
- Apply the knowledge of electrochemical techniques to study various ions present in the industrial effluents. [Apply]

CO – PO MAPPING

CO	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO.1	3	2							2	2				
CO.2	3	3							2					
CO.3	3	2							2					
CO.4	3	1				1	1		1			2		
CO.5	3	2				1	1		1			1		
CO.6	3	2				1	1		1			1		1

19UGM131	INDUCTION PROGRAMME	L	T	P	C
		0	3	0	0

COURSE OBJECTIVES:

- To rejuvenate the Body and Mind
- To strengthen Attitude and soft skills
- To practice Moral values of life.

UNIT I PHYSICAL ACTIVITY 10

Zumba - Bokwa Fitness – Yoga – Mediation – Fine Arts

UNIT II CREATIVE ARTS 5

Painting – Class Painting – Wall Painting – Art from waste

UNIT III UNIVERSAL HUMAN VALUES & EMINENT SPEAKERS 5

Ethical values – Ambition and Family Expectation, Gratitude, Competition and Excellence – Belief – Morality of life – Guest Lecture by Eminent personality

UNIT IV LITERARY

Elocution - Essay writing Competition - Impromptu Session - Dance and singing competition

UNIT V PROFICIENCY MODULES 15

Toastmaster club meet

UNIT VI INDUSTRIAL & LOCAL VISIT 8

Vaigai Dam – Theni - VOC- Port-Tuticorin - Madurai Radio City-Madurai - Aavin Milk –Madurai-NSS Activities.

UNIT VII FAMILIARIZATION OF THE DEPARTMENT AND INNOVATION 2

Department Introduction and Purpose of Course - Eminent speakers – Scope and Feature of the Course - Latest Innovation.

Total: 45 PERIODS

REFERENCE BOOK:

Student Induction Programme: A Detailed Guide by AICTE, New Delhi.

COURSE OUTCOMES:

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

- Practice physical activities regularly.
- Implement creativity in drawing and waste material.
- Communicate their ideas effectively.
- Identify inputs and outputs of different industry process.
- Describe the scope and features of their programme of study.

19UEN201	COMMUNICATION SKILLS FOR PROFESSIONALS *(Common to all branches)*	L 1	T 0	P 1	C 1.5

COURSE OBJECTIVES:

- Improve their oral expression and thought
- Develop their confidence and ability to speak in public
- Develop their capacity for leadership

Project 1 **SELF INTRODUCTION & DELIVER A SPEECH BEFORE AUDIENCE (Time: 5 to 7 minutes)**

To Speak in front of an audience with courage.

Make your message clear, with supporting material.

Create a strong opening and conclusion.

Project 2 **SPEAK ON THE CHOSEN CONTENT (Time: 5 to 7 minutes)**

Select a general topic and bring out specific purposes.

Avoid using notes.

Use symbolic ideas to develop your ideas.

Project 3 **USE EFFECTIVE BODY LANGUAGE & INTONATION (Time: 5 to 7 minutes)**

Use appropriate posture, gestures, facial expressions and eye contact to express your ideas.

Use proper intonation and adequate speech module.

Project 4 **PRESENT YOUR TOPIC WITH VISUAL AIDS (Time: 5 to 7 minutes)**

Persuade your points with suitable illustration, specific facts, examples

Use suitable visual aids to present your topic with confidence.

Project 5 **GRASP THE ATTENTION OF THE AUDIENCE (Time: 5 to 7 minutes)**

Influence your listeners by adopting holistic viewpoint.

Use emotions, stories, and positive quotes in your speech.

Total: 30 PERIODS

REFERENCE BOOKS:

1. Competent Communication- A Practical Guide to becoming a better speaker, Toastmasters International, USA.
2. Norman Lewis – Word Power Made Easy, Pocket Book Publication, 2019.

COURSE OUTCOMES:

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

- Apply Language skills to write and speak effectively C-K6
- Select the right words and sentence to communicate ideas clearly and accurately C-K6

- Exhibit good postures and proper attire to present the ideas effectively C-K6
- Present the ideas effectively using visual aids. C-K6
- Communicate with clarity and present the ideas effectively to the audience C-K6

CO- PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1									2	3				
CO2									2	3				
CO3									2	3				
CO4									2	3				
CO5									2	3				

19UMA205	CALCULUS AND TRANSFORM TECHNIQUES (ONLY FOR EEE)	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To develop an understanding of the basics of vector calculus comprising of gradient, divergence and curl, and line, surface and volume integrals and the classical theorems involving them.
- To make the student acquire sound knowledge of Laplace transform and its properties and sufficient exposure to the solution of certain linear differential equations using the Laplace transform technique.
- To acquaint the student with Fourier transform techniques used in variety of situations.

UNIT I SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 8+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Applications of ODE in Electrical Engineering.

UNIT II VECTOR CALCULUS 8+3

Gradient Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields –Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Applications of Vector calculus in Electrical Engineering.

UNIT III LAPLACE TRANSFORM 9+3

Existence conditions – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function, impulse function and periodic function - Inverse Laplace transform – Convolution theorem (excluding Proof). Applications of Laplace Transforms in Electrical Engineering.

UNIT IV FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic analysis - Application of Fourier series in Electrical Engineering.

UNIT V FOURIER TRANSFORMS 9+3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity - Application of Fourier Transform in Electrical Engineering.

SUPPLEMENT TOPIC (for internal evaluation only) 3

Evocation / Application of Mathematics.

Total: 45 (L) + 15 (T) = 60 PERIODS

TEXT BOOKS:

1. Veerarajan.T “Engineering Mathematics” Tata McGraw Hill Publishing Company, New Delhi, 2008.
2. Bali N. P and Manish Goyal, “Text book of Engineering Mathematics”, Laxmi Publications (P) Ltd., New Delhi, 3rd Edition, (2008).
3. Grewal. B.S, “Higher Engineering Mathematics”, Khanna Publications, New Delhi, 43rd Edition, (2014).

REFERENCE BOOKS:

1. Ramana B.V, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, (2010).
2. Kreyszig. E, “Advanced Engineering Mathematics”, John Wiley & Sons, New York, 10th Edition, (2011).
3. Jain R.K and Iyengar S.R.K, “Advanced Engineering Mathematics”, Narosa Publishing House Pvt. Ltd., New Delhi, 3rd Edition, (2007).
4. Agarwal R.S., “Quantitative Aptitude”, S. Chand Publications, New Delhi, 7th Edition, (2008), pp. 341-370, 384-404.

COURSE OUTCOMES:

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

- Apply the knowledge of higher order ordinary differential equations in real life engineering problems.(CO1) Apply – K3
- Apply the concept vector identities in problem solving and evaluate the line, surface and volume integrals.(CO2) Apply – K3
- Apply Laplace Transform methods to solve initial value problems for constant coefficient linear ODEs.(CO3) Apply – K3
- Apply the knowledge of Fourier series for the given function or Discrete data and compute the Periodic function arising in the study of Engineering problems.(CO4) Apply – K3
- Apply the acquired knowledge of Fourier transform and its properties which are used to transform signals between time and frequency domain.(CO5) Apply – K3
- Understand the basic concept of periodic function, scalar potential and order of differential equation. (CO6) Understand-K2

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3			1								1	2	
CO2	3			1								1	2	
CO3	3			1								1	2	
CO4	3			1								1	2	
CO5	3			1								1	2	
CO6	3			1								1	2	

19UPH205	PHYSICS FOR INFORMATION SCIENCE (COMMON TO EEE,CSE & IT BRANCHES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the essential principles of physics for information science and related Engineering applications.
- To demonstrate the concepts of conduction in conductors.
- To enable the students to understand the dielectric and magnetic materials.
- To apply fundamental knowledge in the area of fiber optics.

UNIT I CONDUCTING MATERIALS 12

Introduction-Conduction in metals-mobility and conductivity – classical free electron theory of metals –merits and demerits- Electrical and thermal conductivity (derivation)– Wiedemann – Franz law – Lorentz number– Fermi distribution function-Effect of temperature on Fermi function-Density of energy states – carrier concentration in metals.

UNIT II TRANSPORT PROPERTIES OF SEMICONDUCTORS 10

Introduction- Properties-Types of semiconductor –Electron and hole concentration -Intrinsic Carrier Concentration–Expression for electrical conductivity of a semiconductor-Band gap determination- Hall effect and its applications.

UNIT III MAGNETIC AND DIELECTRICS MATERIALS 13

Introduction–Classification of magnetic materials – Domain theory – Hysteresis –soft and hard magnetic material-Ferrites-Magnetic storage devices-hard disc-compact disc-RAM-ROM-Applications -Introduction- Types of polarization – Dielectric loss-Dielectric breakdown-Capacitor and its types- Applications.

UNIT IV FIBRE OPTIC COMMUNICATION 10

Introduction- Liquid crystal-LCD and its phases-LED-Diode Laser-Principle and propagation of optical fibres - Types of optical fibre- Attenuation- Fibre optic communication systems (Block diagram)- Fibre optic sensors –Temperature and pressure sensor-Applications.

Total: 45 PERIODS

TEXT BOOKS:

1. William D. Callister, Jr. “Material Science and Engineering”, Seventh Edition, John Wiley & Sons Inc. New Delhi, 2015
2. Dr. Mani.P, “Engineering Physics II ”, Dhanam Publications, Edition ,2018, Chennai
3. Rajendran.V, “Engineering,Physics”, Tata Mc-Graw Hill Publishing Company limited, New Delhi, Revised Edition 2016.

REFERENCE BOOKS:

1. Raghuvenshi G.S., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2014.
2. Arul doss .G., “Engineering Physics”, PHI Learning Limited, New Delhi, Revised Edition 2013.
3. Marikani .A., “Engineering Physics”, PHI Learning Private Limited, New Delhi, Revised Edition 2012.
4. Sankar B.N., and Pillai .S.O., “Engineering Physics – I”, New Age International Publishers Private Limited, New Delhi, Revised Edition 2015.

COURSE OUTCOMES:

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

- Summarize the importance of free electrons in determining the properties of metals, semiconductors and dielectric materials. [Understand]
- Interpret the characteristics of conducting materials and semiconducting materials in terms of band gap and charge carriers [Analyze]
- Apply the concept of spin and orbital motion of electrons in determining magnetic properties of materials and concept of polarization in dielectric materials having specific engineering applications. [Apply]
- Apply the principle of Laser in optical fiber communication [Apply]
- Analyze the structural behavior and properties of conducting, semiconducting and magnetic Materials to select suitable material for industrial application. [Analyze]
- Illustrate the strategies of magnetism and fiber optics to facilitate and to solve the engineering problems [Apply]

CO-PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2											2		
CO2	3	2										2		
CO3	3	2										2		
CO4	3	2								2		2		
CO5	3	3							2			2	2	
CO6	3	3	2						3			3	2	

19UCY204	ENVIRONMENTAL SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of Environment and ecosystem.
- To acquire knowledge about the impact of environmental pollution.
- To understand the importance of environmental issues in the society.
- To gain knowledge about the impact of environment related to human health.
- To gain knowledge in alternative energies.

UNIT I ENVIRONMENTAND ECOSYSTEMS 9

Definition, scope and importance of environment – Need for public awareness – Conceptofecosystem–Structureandfunctionofecosystem–Producers,consumersand decomposers-Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Aquatic ecosystems (c) Grass land ecosystem.

UNIT II ENVIRONMENTALPOLLUTION 9

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution - pollution case studies - Role of an individual in prevention of pollution –Disaster management: floods, earthquake, cyclone and landslides.

UNIT III SOCIAL ISSUES ANDTHEENVIRONMENT 9

Water conservation, rain water harvesting, watershed management – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. Environmental laws/Acts, (EPA).

UNIT IV HUMAN POPULATION ANDTHEENVIRONMENT 9

Population growth, variation among nations – Population explosion – Human rights – Family welfare programme – Environment and Human Health – Human Rights Value education – HIV / AIDS – Women and child welfare – Role of information technology in environment and human health.

UNIT V FUTURE POLICYAND ALTERNATIVES 9

Introduction to future policy and alternatives-fossil fuels-nuclear energy-solar energy-wind energy - hydroelectric energy-geothermal energy - tidal energy – sustainability - green power-nanotechnology.

Total: 45 PERIODS

TEXT BOOKS:

1. AnubhaKaushik, kaushik C.P., “Environmental Science and Engineering”,Third Edition, New Age International, New Delhi, 2009.
2. Benny Joseph “Environmental Science and Engineering”, Tata Mc-Graw Hill, New Delhi, 2006.

REFERENCE BOOKS:

1. Gilbert M.Masters, ‘Introduction to Environmental Engineering andScience’, Pearson Education,Upper saddle River, New Jersey, 2008.
2. Miller T.G. Jr., Environmental Science”, Wadsworth Publishing Company, Belmont, California, 2005.
3. De A.K., “Environmental Chemistry”, Wiley Eastern Ltd., New Delhi,2001.
4. Trivedi R.K., Goel P.K., “Introduction to Air Pollution”, Techno-Science Publication, Jaipur,2005.

COURSE OUTCOMES:

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

- Understand the basic concept of structure and function of ecosystem [Understand]
- Apply the knowledge of various pollution types to prevent the ecosystem and Environment [Apply]
- Analyze the environmental problem to report the social issues and the environment. [Analyze]
- Compare the suitable methods for conservation and sustainable development of natural resources [Analyze]
- Apply the principles of value education with respect to human population to preserve environment [Apply]
- Analyze the current energy crisis and suggest a suitable sustainable alternatives that promotes social health and environmental prospects. [Analyze]

CO-PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	1				2	3					2		
CO2	3	1				2	3					2		
CO3	3	1				2	3					2		
CO4	3	1				2	3					2		
CO5	3	1				2	3					2		
CO6	3	1				2	3					2	1	

19UEE205	INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- This course facilitates the students to get a comprehensive exposure to electrical and electronics engineering.

UNIT I **HISTORY AND SIGNIFICANCE OF ELECTRICAL AND ELECTRONICS ENGINEERING** **9**

History, major inventions, scope, significance and job opportunities in electrical and electronics engineering, brief overview of various energy resources.

UNIT II **BASIC CIRUCUIT ELEMENTS** **9**

Basic circuit elements (Resistor, Inductor and capacitor) -Series and Parallel connections of basic circuit elements, Ohm's law and Kirchoff's law.

UNIT III **INTRODUCTION TO POWER SYSTEM** **9**

Basics of energy conversion, structure of electric power system, power apparatus used in various industries and importance of electrical safety.

UNIT IV **INTRODUCTION OF ENERGY AUDIT** **9**

Basic ideas about utility supply, electrical tariff, energy audit and importance of energy conservation and conservative measures.

UNIT V **INTRODUCTION TO ELECTRICAL AND ELECTRONIC CIRCUITS** **9**

Introduction to different types of electrical circuits, house wiring, Diode- PN Diode, Zener Diode, Rectifiers, Electrical and Electronics testing and measuring equipment.

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TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the major invention, scope and significance of Electrical and Electronics Engineering and understand the various energy resources. [Understand]
- Illustrate the structure of electric power system, power apparatus used in various industries and
  importance of electrical safety [Understand]
- Understand the importance the energy tariff, energy audit and energy conservation.

[Understand]

- Select suitable Electric circuit for house wiring, and demonstrate the working of testing and measuring
  equipments. [Understand]
- Apply basic circuit laws to compute the electrical quantities in circuits. [Apply]
- Analyze the characteristics of basic electronics devices and select suitable device for various applications. [Analyze]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1												2		
CO2						2								
CO3							2							
CO4														
CO5	3													
CO6		2												

19UME226	BASIC CIVIL AND MECHANICAL ENGINEERING (Common to EEE)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of thermal systems
- To understand the basics of building construction and infrastructures

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 9

Surveying:

Objects – types – classification – principles – measurements of distances – angles –leveling – determination of areas – illustrative examples.

Civil Engineering Materials:

Bricks – stones – sand – cement – concrete – steel sections

UNIT II BUILDING COMPONENTS AND STRUCTURES 9

Foundations:

Types, bearing capacity – Requirement of good foundations - Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 9

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV IC ENGINES 9

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

Total: 45 PERIODS

TEXT BOOKS:

1. Shanmugam G. and Palanichamy M.S., “Basic Civil and Mechanical Engineering”, Tata

Mc-Graw Hill Publishing Co., New Delhi, 1996.

2. Venugopal K., Prabhu Raja V., and Sreekanjana G., “Basic Civil and Mechanical Engineering”, Anuradha Publications, Third Edition 2010.

REFERENCE BOOKS:

1. Ramamrutham S., “Basic Civil Engineering”, DhanpatRai, Publishing Co. (P) Ltd, 1999.
2. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, 2005.
3. Shantha Kumar S.R.J., “Basic Mechanical Engineering”, Hi-Tech Publications, Mayiladuthurai, 2000.

COURSE OUTCOMES:

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

- Summarize the measurement of landscape and different building materials with norms. [Understand]
- Classify the different building structure and its applications relevant to civil engineering practice. [Understand]
- Interpret the ideas of variety of energy sources considering the norms of engineering practice. [Understand]
- Explain the working principle of I.C engines. [Understand]
- Discuss the working principle of Refrigeration and Air conditioning systems. [Understand]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2					3	2	3					2	
CO2	2					3	3	2					2	
CO3	2					2	2	3					2	
CO4	2												2	
CO5	2					2		2					2	

19UGS210 **ENERGY AND ENVIRONMENTAL SCIENCE LABORATORY** **L T P C**

0 0 3 1.5

OBJECTIVES :

- To analyze the band gap, moment of inertia, thermal conductivity and rigidity modulus of the Materials.
- To gain knowledge in photonics.
- Apply the theoretical concepts to perform lab experiments**.**
- To assess the water quality parameters.
- To acquire knowledge on water quality parameters for the analysis of industrial effluents.

PHYSICS LABORATORY
(COMMON TO ALL BRANCHES)

LIST OF EXPERIMENTS

1. Determination of Energy band gap of a semiconductor.
2. Torsion pendulum – Determination of Moment of inertia of a metallic disc and rigidity modulus of a given metallic wire.
3. Spectrometer - Determination of wavelength of mercury spectrum using grating.
4. Laser – Determination of numerical aperture and acceptance angle of an optical fiber
5. Newton's rings – Determination of radius of curvature of a convex lens
6. Lee's Disc - Determination of thermal conductivity of a bad conductor.
7. Determination of Solar cell characteristics using optical transducers kit.

A minimum of Five experiments shall be offered

CHEMISTRY LABORATORY
(COMMON TO ALL BRANCHES)

LIST OF EXPERIMENTS

1. Estimation of hardness of water by EDTA method.
2. Estimation of alkalinity of water sample.
3. Estimation of Chloride in water sample (Argentometric method)
4. Determination of DO in water
5. Estimation of chromium in tannery wastes
6. Estimation of available chlorine in bleaching powder
7. Estimation of iron by Spectrophotometry.

8. Determination of acidity of industrial effluents.

A minimum of FIVE experiments shall be offered

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- Apply the principles of Light and Elasticity to determine the Engineering properties of materials [Apply]
- Analyze the thermal conductivities of different bad conductors [Analyze]
- Analyze the Characteristics of a semiconductor [Analyze]
- Apply the basic knowledge of water quality testing for environmental sustainability. [Apply]
- ***Analyze the water quality parameters for industrial effluents to prevent water pollution. [Analyze]***
- Estimate the quality of water that suits for domestic and industrial applications [Apply]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2										2		
CO2	3	2										2	2	
CO3	3	2										2		
CO4	3	2				2	3		1			2		
CO5	3	2				2	3		1			2		
CO6	3	2				2	3		1			2		1

19UEE211	INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES :

- This course facilitates the students to get a basic practical exposure to electrical and electronics engineering.

LIST OF EXPERIMENTS

1. Verification of Ohm's Law
2. Verification of Kirchoff's Laws.
3. Measurement of Electrical Quantities voltage, current, power ad power factor in RLC Circuits.
4. Study of Batteries.
5. Characteristics of PN Junction Diode.
6. Characteristics of Zener Diode.
7. Characteristics of BJT.
8. Study of UPS.
9. Study of Electrical and Electronic software packages.
10. Field visit to College EB Section.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

- Demonstrate the behavior of RLC circuits with electrical quantities.[Understand]
- Demonstrate the behavior of RLC circuits with electrical quantities.[Understand]
- Interpret the basic construction, working and types of Batteries and select suitable battery for particular applications. [Apply]
- Illustrate the characteristics of Semiconductor diodes and Transistor and develop power supply circuits. [Apply]
- Interpret the basic structure and working of UPS and outline the electrical &electronics software tools.[Understand]

CO-PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2							2			2	2	2
CO2	2								2			2		
CO3	3					2	3		2			2		
CO4	3								2			2		2
CO5	2	3			3	2	3		2			2		2
CO6	3	2							2			2	2	2

19UMA324	PROBABILITY, STATISTICS, COMPLEX ANALYSIS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To make the student acquire sound knowledge of fundamentals and applications of statistics which will greatly help at the data analysis stage of comparative experiments.
- To make the student acquire sound knowledge of standard distributions that can describe real life phenomena.
- To acquaint the student with the roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and Eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions - Normal, t, Chi-square and F distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes

UNIT II PROBABILITY & RANDOM VARIABLES 9+3

Axioms of probability - Conditional probability - Total probability - Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Normal and Exponential- Joint probability distributions - Marginal and Conditional distributions – Covariance - Correlation and Regression.

UNIT III SOLUTION OF ALGEBRAIC, TRANSCENDENTAL EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Iteration method – Newton-Raphson method – Gauss Elimination method – Pivoting – Gauss Jordan methods –iterative methods : Gauss Jacobi method ,Gauss Seidel method - Eigen values of a matrix by Power method – Jacobi's method for a real symmetric matrix.

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor series method – Euler method for first order equation – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V COMPLEX INTEGRATION 9+3

Statement and applications of Cauchy's integral theorem, Cauchy's integral formula and Cauchy Residue Theorem – Taylor's and Laurent's expansions – Applications of residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding Poles on the real axis).

Total: 45 (L) + 15 (T) = 60 Periods

TEXT BOOKS:

1. Gupta S.C., Kapoor V.K. "Fundamental of Mathematical Statistics" 10th Edition ,Sultan Chand and Sons , New Delhi 2002.
2. Grewal, B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 35th Edition, (2010).
3. Veerarajan, T., "Probability and Random Processes" 4th Edition Tata McGraw-Hill, New Delhi, (2015).

REFERENCE BOOKS:

1. Bali N.P., Manish Goyal and Watains, "Advanced Engineering Mathematics", Firewall Media (An imprint of Laxmi Publication Private limited) New Delhi, 7th Edition, (2009).
2. Ramana.B.V, "Higher Engineering Mathematics" Tata McGraw Hill, New Delhi, 11th Reprint (2010).
3. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 3rd Edition, (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India, 10th Edition, (2011).

COURSE OUTCOMES:

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

- Analyse the concept of testing of hypothesis for small and large samples in Real life Problems (CO1). Analyze – K4
- Apply the knowledge of concepts of probability to acquired knowledge of standard Distributions, Correlation and regression .(CO2) Apply – K3
- Apply numerical techniques to solve linear, nonlinear equations and Eigen value problems of a Matrix by Numerically.(CO3) Apply – K3
- Apply the knowledge of numerical techniques and methods for solving first and second order Ordinary Differential Equation. (CO4) Apply-K3
- Apply the knowledge of singularities, residues and applying to evaluate complex integration.(CO5) Apply – K3
- Understand the basic concept of probability , Random Variable and statistics. (CO6) Understand-K2

CO-PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3		1								1	2	
CO2	3			1								1	2	
CO3	3			1								1	2	
CO4	3			1								1	2	
CO5	3			1								1	2	
CO6	3			1								1	2	

19UEE302	ELECTRICAL CIRCUIT ANALYSIS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To introduce network theorems for the analysis of electrical circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits
- To study the three phase circuits
- To study two port circuit behaviors.

MODULE 1 DC AND AC CIRCUITS **6**

Introduction to DC Circuits, Network reduction: Voltage and Current division – Source Transformation – Star Delta conversion. Introduction to AC circuits: Average and RMS value, Impedance, Admittance, Power and Power factor.

MODULE 2 NETWORK THEOREMS **6**

Superposition Theorem, Thevenin Theorem, Norton Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem.

MODULE 3 RESONANCE AND COUPLED CIRCUITS **12**

Series and Parallel Resonance – Frequency Response – Quality factor and Bandwidth – Self and Mutual Inductance – Coefficient of Coupling – Tuned circuits.

MODULE 4 TRANSIENT RESPONSE ANALYSIS **12**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

MODULE 5 THREE PHASE CIRCUITS **12**

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – Power Measurement in three phase circuits - Simulation of Power measurement in three phase circuits.

MODULE 6 TWO PORT NETWORK **12**

Two Port Networks – Impedance Parameters, Admittance Parameters, Transmission Parameters and Hybrid parameters – Interconnections of two port networks.

Total: 60 Periods

TEXT BOOKS:

1. A.Sudhakar, Shyammohan.S.Palli, “Circuits and Networks: Analysis and Synthesis” McGraw Hill Education, 5th Edition 2015.
2. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013

REFERENCE BOOKS:

1. C. K. Alexander and M. N. O. Sadiku, “Fundamentals of Electric Circuits”, McGraw Hill Education, 2004.
2. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2006.
3. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
4. John Bird, “Electrical Circuit Theory and Technology”, Routledge, 2012.

COURSE OUTCOMES:

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

- Understand the basic concept of dc and ac electric circuits. [Understand]
- Apply Network Theorems to both DC and AC circuits. [Apply]
- Analyze and determine the transient response of first order and higher order electric circuits. [Analyze]
- Analyze the three phase electrical parameters for balanced and unbalanced loading. [Analyze]
- Design tuned and filters circuit using the basic concepts of resonance using MATLAB. [Apply]
- Make an effective communication and presentation in a team to demonstrate the concepts of electric circuit [Valuing]

19UEE303	ELECTRICAL MACHINES - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the production of torque and EMF in Electrical Machines.
- To demonstrate the construction, operation and characteristics of various types of DC machines.
- To choose the suitable dc machine for a particular application.
- To understand the construction, operation and characteristics of transformers
- To estimate the performance of Transformers.

MODULE 1 PRINCIPLES OF ENERGY CONVERSION 9

Faraday's law of electromagnetic induction -singly and doubly excited magnetic field systems - EMF and torque production in rotating machines

MODULE 2 DC GENERATORS 9

Construction – Windings – Principle of operation – Types – Characteristics. Armature reaction and commutation - parallel operation-Applications

MODULE 3 DC MOTORS 9

Principle of operation – Types – Characteristics – Starting and Speed control –Various testing-Applications

MODULE 4 TRANSFORMERS 9

Construction – Principle of operation – Types – phasor diagram of practical transformer on no load and load – Equivalent circuit –Voltage regulation and efficiency- Auto transformer.-Applications

MODULE 5 TRANSFORMER TESTING 9

Testing of transformers –Polarity, open circuit, short circuit and Sumpner‟s test –Three phase transformers connections- Parallel operation

Total: 45 Periods

TEXT BOOKS:

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, 2017.
2. P. S. Bimbhra, Electrical Machinery, Khanna Publishers, Delhi, 2018.
3. E.Fitzgerald, Charles Kingsley, Stephen.D.Umans, Electric Machinery, Tata McGraw Hill publishing Company Ltd, New Delhi ,2015.
4. StephenJ.Chapman, Electric Machinery Fundamentals, Tata McGraw Hill, New Delhi,2018

REFERENCE BOOKS:

1. Theraja B.L., “A Text Book of Electrical Technology Vol. II ”, S.Chand & Co. Ltd, 2018.
2. Murugesh Kumar K.,”DC Machines and Transformers ”, Vikas publishing house Pvt Ltd, 2014.
3. Mehta. V.K., “ Principles of Electrical Machines ”, S.Chand & Co. Ltd, 2017.
4. J.B. Gupta, Theory and performance of Electrical Machines- S.K. Kataria and sons-New Delhi,2013

COURSE OUTCOMES:

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

- Demonstrate the construction and operating principles of DC Machines and Transformers [Understand]
- Compute the losses, efficiency and regulation of transformer using different testing methods. [Apply]
- Analyze the characteristics of DC Generators and choose the suitable dc Generator for a particular application [Analyze]
- Analyze the performance of DC Motors based on its environmental impacts and choose the suitable dc motor for a particular application [Analyze]
- Analyze the performance of the transformers using Phasor diagram and Equivalent circuit model. [Analyze]
- Communicate effectively to propagate ideas to the engineering community and promote teamwork [Valuing]

CO –PO MAPPING

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1														
CO2	**3**												**2**	
CO3		**3**											**3**	
CO4		**3**					3						**3**	
CO5		**3**											**3**	
CO6	**3**	**3**		**3**										

19UEE304	ANALOG ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To be familiar with the structure of basic electronic devices
- To be exposed to the operation and application of electronic devices and their circuits
- To analyze circuit characteristics with signal analysis using Op-amp Ics.
- Illustrate the applications of IC555 in astable and monostable mode
- Explain the application of PLL for frequency multiplication/division and frequency translation

MODULE 1 ELECTRONIC DEVICES AND THEIR CHARACTERISTICS 9

PN junction diodes – structure, operation and VI characteristics: drift and diffusion current, transient capacitance – BJT, JFET, MOSFET: structure, operation and characteristics; biasing; UJT based relaxation oscillator

MODULE 2 AMPLIFIER CIRCUITS 9

BJT small signal model – Analysis of CE amplifier, Gain and Frequency response – Differential Amplifier - Multi-stage amplifier - Common mode and Differential mode analysis - Current mirror circuits - Introduction to internal circuit of typical OPAMP.

MODULE 3 OPERATIONAL AMPLIFIER AND ITS APPLICATIONS 9

Basic concepts, Differential amplifiers, Ideal op-amp, Parameters of op-amp. Basic op-amp applications- Scale changer, Inverting and non-inverting amplifiers, Summer and Subtractor, Differentiator, Integrator, Instrumentation amplifier, Precision rectifier.

MODULE 4 COMPARATORS AND WAVEFORM GENERATORS 9

Comparator - Regenerative comparator, Square wave generator - Triangular wave generator, Sine wave oscillators - RC phase shift and wien bridge oscillators.

MODULE 5 SPECIAL ICS 9

555 Timer circuit: Functional block diagram, characteristics & applications – Astable and monostable multivibrator -566 Voltage Controlled Oscillator circuits - PLL Phase Locked Loop applications -Function generator circuit – Linear Voltage regulators.

Total: 45 Periods

TEXT BOOKS:

1. David A bell, " Electronic circuits" , Oxford University Press, 2011.
2. Ramakant A Gayakwad , " Opamps and Linear Integrated Circuits" , IV edition,

PearsonEducation/ PHI, 2009

3. D. Roy Choudary, S.B. Jain, " Linear Integrated Circuits", Third edition, New Age publishers, 2014.

REFERENCE BOOKS:

1. Millman and Halkias, " Integrated Electronics", McGraw Hill Publications,

2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.

COURSE OUTCOMES:

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

- Understand the structure, working principle and operation of analog devices and circuits. [Understand]
- Design a suitable circuit for linear and non – linear applications by applying the knowledge of Semiconductor devices. [Apply]
- Design a circuit for the given application using special ICs. [Apply]
- Analyze the characteristics of semiconductor devices and select suitable device for the given application. [Analyze]
- Compare the performance characteristics of analog circuits and recommend a suitable circuit for given application. [Evaluate]
- Make an effective communication and presentation in a team to demonstrate the concepts of Linear Integrated Circuits. [Affective Domain]

CO – PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3												2
CO5				3										
CO6									3	3				

19UEE305	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

MODULE 1 INTRODUCTION 9+3

Sources and Effects of Electromagnetic Fields-Vector fields-Different Coordinate Systems-Differential Elements- Del Operator-Gradient- Divergence and curl of a vector- Divergence Theorem - Stoke's Theorem.

MODULE 2 ELECTROSTATIC FIELD 12+3

Coulomb's Law- Electric field Intensity-Field due to point and continuous charges-Different types of charge densities-Electric Charge density, Electric Flux Density- Gauss Law and its applications-Electric Potential-Electric field due to infinite line charge, charged circular ring-Equipotential plots-Dielectric polarization-Dielectric strength - Permittivity, Dielectric strength of Materials. Multiple Dielectrics and field behavior at the interface between conductor and free space-Poisson's and Laplace's equations- Calculation of Capacitance for various application and energy storage. Simulation of Electric Fields.

MODULE 3 MAGNETO STATIC FIELDS 9+3

Lorentz Law of Force, Magnetic field Intensity-Biot-Savart's Law and Ampere's Law- Magnetic fields due to straight conductors, Circular loop - Magnetic Flux Density and Magnetic Field Intensity, Permeability and strength of magnetic materials. Field Behavior at the interface of magnetic materials –Scalar and vector potential - Magnetic force - torque - Inductance- Energy density. Simulation of magnetic fields.

MODULE 4 ELECTRO DYNAMIC FIELDS 9

Faraday's laws, induced emf – Transformer and motional EMF Force and Torque: Forces and Energy in quasi stationary Electromagnetic fields – Maxwell's equations (differential and integral forms) – Displacement current- Relation between field theory and circuit theory.

MODULE 5 ELECTRO MAGNETIC WAVES 9+3

Generation – Electro magnetic wave equations – wave parameters: velocity, intrinsic impedance, propagation constant- waves in free space, lossy and lossless dielectrics, conductors – skin depth, Poynting vector – Plane wave reflection and refraction.

Total: 60 Periods

TEXT BOOKS:

1. Cheng, D.K., “Field and Wave Electromagnatics”, Pearson Education (Singapore) Pte. Ltd., 2nd Edn., 1989.
2. Hayt, W.H., J.A. Buck, “Engineering Electromagnetics”, Tata McGraw Hill.

REFERENCE BOOKS:

1. Edward C. Jordan & Keith G. Balmain, “Electro-magnetic waves & Radiating System”, PHI.
2. Deepak Sood, “Field & Wave, A Fundamental Approach”, University Science Press.
3. S. C. Matapatra, SudiptaMahapatra, “Principles of Electromagnetics”, Tata McGraw Hill.
4. Matthew Sadiku, “Principles of Electromagnetics”, Oxford University Press.
5. A. R. Harish, M. Sachidananda, “Antennas & Wave Propagation”, Oxford University Press.

COURSE OUTCOMES:

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

- Understand the concepts of different coordinate systems and EMF generation. [Understand]
- Apply vector calculus to electrostatic and magnetostatic fields for computing the field parameters. [Apply]
- Analyze different wave parameters in various medium. [Analyze]
- Apply Maxwells equations to analyze and predict the behavior of electromagnetic fields in different situations [Apply]
- Develop a circuit to measure the electromagnetic radiations. [Create]
- Make an effective communication and presentation in a team to demonstrate the concepts of Electromagnetic Radiations. [Affective Domain]

CO – PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3		3												
CO4	3													
CO5			3											
CO6									3	3				

19UEE306	ELECTRICAL MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the general instrument system, error, calibration etc.
- To familiarize the comparison methods of measurement.
- To explain storage and display devices, various transducers and data acquisition system

UNIT I STATISTICAL DATA & ERROR ANALYSIS 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement– Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeters – 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, Power factor meter.

UNIT III COMPARISON METHODS OF MEASUREMENTS 9

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Measurement of earth resistance – Localization of Cable Faults, insulation resistance – Megger.

UNIT IV STORAGE AND DISPLAY DEVICES 9

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, Digital storage Oscilloscope - dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Transducers selection - Types – Resistive transducer: Potentiometer - Strain gauge – Inductive transducer: LVDT – Capacitive transducer - Measurement of pressure – Piezoelectric transducers – Measurement of temperature: RTD, thermistor, thermocouple, optical and radiation pyrometers – Elements of data acquisition system – A/D, D/A converters.

Total: 45 Periods

TEXT BOOKS:

1. Doebelin E.O, “Measurement Systems – Application and Design”, Tata McGraw Hill publishing company, 2003 .
2. Sawhney A.K. , “A Course in Electrical & Electronic Measurements & Instrumentation ”, DhanpatRai and Co, 2004.

REFERENCE BOOKS:

1. Bouwens A.J., " Digital Instrumentation ", Tata McGraw Hill, 1997.
2. Moorthy D.V.S., "Transducers and Instrumentation ", Prentice Hall of India Pvt Ltd, 2007.
3. Kalsi H.S., " Electronic Instrumentation ", Tata McGraw Hill, II Edition, 2004.
4. Martin Reissland., "Electrical Measurements", New Age International (P) Ltd, 2001.
5. Gupta J. B., "A Course in Electronic and Electrical Measurements", S. K. Kataria& Sons, 2003.

COURSE OUTCOMES:

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

- Explain the operation of various measuring instruments, data acquisition system, storage and display devices. [Understand]
- Apply the norms and standards for the calibration of measuring instruments to measure the unknown values using DC & AC potentiometers and bridges. [Apply]
- Select and use the suitable transducers for a given application. [Apply]
- Choose a suitable electrical and electronic instrument for the measurement of electrical quantity. [Analyze]
- Identify the latest trends in measuring systems, storage and display devices for sustainable development. [Analyze]
- Make an effective communication and presentation in a team to demonstrate the concepts of Electrical measuring instruments. [Affective Domain]

CO – PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3					3								
CO3	3													
CO4		3												
CO5												3		
CO6									3	3				

19UEE307 SEMINAR L T P C

0 0 2 1

COURSE OBJECTIVE:

- To create awareness of how to use values in improving professionalism
- To learn about personal and communication styles for team building

Seminar provides an opportunity for the students to express his technical ideas orally through presentation. The seminar facilitates to develop communication skills, the ability to prepare and present technical ideas with clarity of expression, and the ability to analyse the technical ideas critically. The students will be evaluated based on their scientific and technical knowledge, preparation and organization of the presentation, language, manners and style of presentation, clarity of expression, adequacy and use of required tools and references, confidence, attitude and time management. Suitable rubrics will be formed to evaluate the seminar presentation by the Course handling faculty in consultation with the HoD and the general guidelines given by the Principal.

Total: 30 Periods

COURSE OUTCOMES

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

- Analyze the technical ideas critically for expressing it orally through presentation.
- Develop communication skills to present technical ideas with clarity of expressions.

19UEE308	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To introduce network theorems for the analysis of electrical circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits
- To study the three phase circuits
- To study two port circuit behaviors

LIST OF EXPERIMENTS

1. Verification of Mesh and Nodal analysis
2. Verification of superposition Theorem
3. Verification of Thevenin's and Norton's Theorem
4. Verification of Maximum Power Transfer Theorem
5. Verification of Reciprocity Theorem
6. Frequency response of series resonance circuits
7. Frequency response parallel resonance circuits
8. Measurement of time constant for RL, RC and RLC circuits
9. Measurement of energy using single phase energy meter
10. Measurements of three phase power using two wattmeter methods
11. Determination of self, mutual inductances and co-efficient of coupling
12. Study of First & Second Order Circuit Transients by Digital simulation
13. Determination of Two Port Network Parameters

A minimum of TEN experiments shall be offered

Total: 30 Periods

COURSE OUTCOMES

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

- Understand and verify Thevenin's/Norton's theorems, maximum power transfer, and reciprocity theorem applications in electrical circuit simplification. [Understand]
- Apply principles of mesh and nodal analysis to validate circuit solutions experimentally. [Apply]
- Analyze the transient and frequency response of various AC circuits for drawing insightful conclusions about its behavior. [Analyze]
- Develop an effective report and comprehend the technical skill for the given exercise. [Psychomotor Domain]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3		3												
CO4									3	3				
CO5	3.0	3.0							3.0	3.0				

19UEE309	ELECTRICAL MACHINES LABORATORY – I	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To understand the open circuit and load characteristics of DC generator.
- To understand the electrical and mechanical characteristics of DC motor under various Loading conditions.
- To perform the tests to determine the efficiency and regulation of the DC machines and transformers.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of separately excited DC generators.
2. Open circuit and load characteristics of Self excited DC shunt generators
3. Load characteristics of DC compound generator.
4. Load characteristics of DC shunt motor.
5. Load characteristics of DC compound motor.
6. Load characteristics of DC series motor.
7. Predetermination of Efficiency of DC machine using Swinburnes Test.
8. Hopkinson's test.
9. Speed control of DC shunt and DC Series motor.
10. Load test on single phase transformer.
11. Open circuit and short circuit test on single phase transformer.
12. Determination of performance parameters of transformer using Sumpners test.
13. Separation of no-load losses in single phase transformer.
14. Study of three phase transformer connections.
15. Visit to Electrical Machines Manufacturing Industry.

A minimum of TEN experiments shall be offered

Total: 30 Periods

COURSE OUTCOMES:

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

- Compute the efficiency of DC machine by conducting various tests [Apply]
- Analyze the performance characteristics of DC Generators and choose the suitable dc Generator for a particular application [Analyze]
- Evaluate the performance parameters of a single phase transformer using different testing Methods [Evaluate]
- Compute the characteristics of DC motor by various Speed control methods [Apply]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3											3	
CO3				3									3	
CO4	3													
CO5									3	3				

19UEE310	ANALOG ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode and zener diode.
2. Characteristics of Transistor using various configurations.
3. Frequency response of common emitter and JFET/MOSFET amplifier
4. Characteristics of FET and MOSFET.
5. Differential amplifier using FET/MOSFET.
6. Half wave and full-wave rectifier using op-amp
7. Schmitt trigger circuit using op-amp
8. Timer IC application:
   NE/SE 555 timer in Astable, Monostable operation.
9. Application of Op-Amp: Slew rate verifications, inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Analog to Digital Converter and Digital to Analog Converter: Verification of A/D conversion using dedicated IC's.
11. Frequency responses of low pass and band pass active filters.
12. Design of oscillator using opamp.

Total: 30 Periods

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

- Apply the opamp for designing signal conditioning circuits. [Apply]
- Analyze the frequency response of various semiconductor devices. [Analyze]
- Analyze the characteristics of various semiconductor devices. [Analyze]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain]

CO-PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												
CO3		3												
CO4									3	3				

19UGM332	BIOLOGY FOR ENGINEERING APPLICATIONS	L	T	P	C
	(Common to Agri, Civil, Chem, ECE, EEE & IT)	2	0	0	P/F

COURSE OBJECTIVES:

- To provide a basic understanding of biological mechanisms of living organisms and the human biology from the perspective of engineers.
- To encourage engineering students to think about solving biological problems with engineering principles and tools.

MODULE – 1 INTRODUCTION AND CLASSIFICATION 5

Introduction to Biology – Comparison of Biology and Engineering – Eye and Camera – Bird flying and Aircraft – Brownian motion and Thermodynamics – Classification – Unicellular or multicellular – Unicellular: Bacteria, Protozoa, Yeast – Multi Cellular: Animals, Humans, Plants, fungi etc. – Ultra structure: prokaryotes or eukaryotes – Habitat: aquatic or terrestrial.

MODULE – 2 DIGESTIVE & RESPIRATORY SYSTEMS – ENZYME 6

Study of digestive – Respiratory systems and their functions –.Enzyme – Classification of Enzyme – Mechanism of Enzyme activity – Enzymes for Industrial Applications: Waste management – Food processing industry – Beverages – Pharmaceutical – Paper Industry etc.

MODULE – 3 GENETICS AND BIO MOLECULES (Basics only) 7

Basics of Genes – DNA structure – Genes and hereditary – Genetic Code – Coding and decoding Genetic information – Gene Mapping – Gene Interactions – Mutations – Genetic disorders – Gene therapy – Biomolecules: Carbohydrates, lipids, nucleic acids, proteins. Biological Applications in Engineering: Genetic Algorithm – Computer Application in Genetic Engineering – Genetic Programming – Genetic Computers.

MODULE – 4 NERVOUS SYSTEM AND CELL SIGNALING 7

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, Digital storage Oscilloscope - dot matrix display – Data Loggers.

MODULE – 5 BIOLOGY AND ITS INDUSTRIAL APPLICATION 5

Bioreactors – Biopharming – Recombinant vaccines – Cloning – Drug discovery – Bioremediation – Biofertilizer – Biocontrol – Biofilters – Biosensors – Biopolymers – Bioenergy – Biomaterials – Biochips.

Total: 30 Periods

TEXT BOOKS:

1. R.C.Dubey, “A Text book of Biotechnology”, S. Chand Higher Academic Publications, 2013.

2. R. Khandpur, “Biomedical instrumentation - Technology and applications”, McGraw Hill Professional, 2004.

REFERENCE BOOKS:

1. Arthur T. Johnson, “Biology for Engineers”, CRC Press, Taylor and Francis, 2nd Edition, 2019.
2. Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, “Cell Biology and Genetics (Biology: The unity and diversity of life Volume I)”, Cengage Learning, 12th Edition, 2008.
3. Gerard J. Tortora and Bryan H.Derrickson, “Principles of Anatomy and Physiology”,15th Edition,Wiley publications, 2016.

COURSE OUTCOMES:

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

- Explain the fundamentals of living things, their classification, cell structure and biochemical constituents. [Understand]
- Apply the concept of plant, animal and microbial systems and growth in real life situations [Apply]
- Analyze biological engineering principles and procedures needed to solve societal issues. [Analyze]

19UEE401	ELECTRICAL MACHINES - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To impart the knowledge on construction and performance characteristics of synchronous Machines.
- To impart the knowledge on construction and performance characteristics of three phase Induction Machines.
- To impart the knowledge on operation of single-phase Induction motor and special machines.

UNIT I AC MACHINE WINDINGS AND MAGNETIC FIELDS 4

Physical arrangement of windings in stator and rotor - single turn coil, active portion and overhang, full-pitch coils, short -pitch coils, concentrated winding, distributed winding - winding distribution factor - Magnetic field produced by a single winding, fixed current and alternating current - Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT II SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors – Winding factors- EMF equation – Synchronous reactance – Synchronous Impedance– Armature reaction – Phasor diagram– Synchronizing to Infinite Bus bar and parallel operation – Synchronizing torque -Power developed– Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Salient pole machine –Two reaction theory –Determination of direct and quadrature axis synchronous reactance using slip test– short circuit transients –Operating characteristics – Capability Curves.

UNIT III SYNCHRONOUS MOTOR 8

Principle of operation – Torque equation – Power input and power developed – Operation on infinite bus bars – V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed–Hunting– damper windings – synchronous condenser.

UNIT IV THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics, Effect of parameter variation on torque speed characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Double cage induction motors –Induction generators

– Synchronous induction motor.

UNIT V STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR **7**

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star- delta starters – Speed control – Voltage control, Frequency control, V/f control– pole changing– Cascaded connection– Slip power recovery scheme.

UNIT VI SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES **8**

Constructional details of single phase induction motor – Equivalent circuit – No load and blocked rotor test – Starting methods of single-phase induction motors – Split phase motors – Capacitor-start capacitor run Induction motor – Shaded pole induction motor – Linear induction motor – Repulsion motor – reluctance motor– Hysteresis motor – AC series motor –Stepper motors.

Total: 45 Periods

TEXT BOOKS:

1. D. P. Kothari and I. J. Nagrath, Electric Machines, Tata McGraw Hill Publishing Company Ltd, Fourth Edition 2018.
2. P. S. Bhimbhra, Electrical Machinery, Khanna Publishers, Seventh Edition 2018.
3. E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, Electric Machinery, Tata McGraw Hill publishing Company Ltd, New Delhi ,2015.
4. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.

REFERENCE BOOKS:

1. B.R.Gupta, ’Fundamental of Electric Machines’ New age International Publishers,3rd Edition, Reprint 2015.
2. Murugesh Kumar, ‘Electric Machines’, Vikas Publishing House Pvt. Ltd, 2002.
3. Theraja B.L., “ A Text of Electrical Technology, Volume-II”, S.Chand& Co Ltd, 2008
4. M.G.Say, Performance and Design of Alternating Current Machines, 3rd Edition, CBS Publisher, 2017
5. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.

COURSE OUTCOMES:

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

- Explain the construction and principle of operation of different types of induction and synchronous Machines. [Understand]

- Determine the performance characteristics of synchronous motor. [Apply]
- Select a suitable starter and speed control method of three phase induction motors for various applications. [Apply]
- Analyze the performance characteristics of Induction motor. [Analyze]
- Compare the voltage regulation of alternator by using various methods. [Analyze]
- Select the AC machines for various application by considering its societal and environental aspects [Evaluate]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3											3	
CO5		3												
CO6				3		2	3							
CO7	3	3		3		2	3						3	

19UEE402	CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce state variable representation of physical systems and study the effect of state feedback.

MODULE 1 INTRODUCTION TO CONTROL PROBLEM 6

Basic Components of a Control System, Industrial Control examples. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Mathematical Modeling of Dynamic Systems: Mechanical, Electrical, thermal and fluid system. Transfer function: Block diagram reduction techniques and Signal flow graphs.

MODULE 2 TIME DOMAIN ANALYSIS 12

Standard test signals. Time response of first and second order systems for standard test inputs. Error coefficient and steady state error. Develop a MATLAB program and analyse the time response of the given system.

MODULE 3 FREQUENCY DOMAIN ANALYSIS 12

Frequency Response of Closed-Loop Systems, Frequency-Domain Specifications, Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. – Gain and phase margin. Develop a MATLAB program and analyse the frequency response of the given system.

MODULE 4 RELATIVE STABILITY ANALYSIS 12

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci. Develop a MATLAB program and analyse relative stability of the given system.

MODULE 5 DESIGN OF CONTROL SYSTEMS 12

Design specifications, Controller Configurations, Time-Domain and frequency domain Interpretation of PD, PI, & PID Controller. Design with Lag, lead and lag-lead controller. Effect of Lag, lead and lag-lead controllers on Time-Domain and frequency domain analysis. Develop a

MATLAB program and design the controller of the given system.

MODULE 6 STATE VARIABLE ANALYSIS 6

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigen values and Stability Analysis. Concept of controllability and observability.

Total: 60 Periods

TEXT BOOKS:

1. Nagrath& Gopal, “Modern Control Engineering”, New Age International, New Delhi
2. Gopal. M., “Control Systems: Principles and Design”, Tata McGraw-Hill, 1997.

REFERENCE BOOKS:

1. Kuo, B.C., “Automatic Control System”, Prentice Hall, sixth edition, 1993.
2. Ogata, K., “Modern Control Engineering”, Prentice Hall, second edition, 1991.

COURSE OUTCOMES:

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

- Explain the various components and techniques involved in control systems, time domain and frequency domain parameters. [Understand]
- Develop mathematical model and compute transfer function of dynamic systems using block diagram reduction and signal flow graph [Apply]
- Determine the time-domain, frequency domain specifications and state space model for the control system. [Apply]
- Analyze the system response for stability in both time and frequency domain using algebraic and graphical representations. [Analyze]
- Examine the system behaviours like stability, controllability, and observability using various stability analysis techniques. [Evaluate]
- Design a linear control systems/ compensators within the constraints for a given application using MATLAB. [Create]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3												
CO5		3		2										
CO6			3		3									

19UEE403	PRINCIPLES OF DIGITAL ELECTRONICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To impart the knowledge of combinational circuit design.
- To impart the knowledge of Sequential circuit design.
- To provide the basic knowledge about Verilog HDL & its use.

UNIT I FUNDAMENTALS OF DIGITAL SYSTEMS AND LOGIC FAMILIES 9+3

Digital signals, digital circuits, review of number systems, binary arithmetic, one's and two's complements arithmetic, Binary codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families - TTL, Schottky TTL and CMOS logic, design using CMOS logic, interfacing CMOS and TTL.

UNIT II COMBINATIONAL CIRCUITS 9+3

AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3 and 4 variables. Adders, Subtractors, Binary multipliers, Multiplexers - Implementation of Combinational circuits using Multiplexers, Demultiplexers, Encoders, Decoders, Parity Generators and Checkers, code converters.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9+3

Clock – Edge and Level, Flip-Flop, Analysis of RS, JK, Master Slave, T and D Flip-Flop, Registers, counters – Pulse forming circuits –– Shift registers –. Synchronous Sequential Logic circuits – Design- state diagram, state table and excitation table - design of counters - Modulo counters, Ring counters. Moore and Mealy models - analysis of synchronous sequential logic circuits - state reduction and state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9+3

Asynchronous sequential logic circuits-Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table – hazards and errors.

UNIT V PROGRAMMABLE LOGIC DEVICES AND INTRODUCTION TO VERILOG HDL 9+3

Semicustom design – Introduction to PLDs – ROM, PAL, PLA, FPLA, and FPLS. Architecture of PLDs – PAL 22V10 - Implementation of digital functions, CPLD, FPGA - Xilinx FPGA, Actel FPGA. Verilog HDL - Modeling styles – structural – Behavioral – Dataflow - Design of simple/ complex combinational and sequential circuits using Verilog - case study on system design.

Total: 60 Periods

TEXT BOOKS:

1. Tocci R J, Widmer N and Moss G. —Digital Systems: Principles and Applications, Pearson, New Delhi, 2013.
2. Donald Givone, —Digital Principles and Design‖, Tata McGraw-Hill, New Delhi 2012
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2015.
4. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
5. J. Bhaskar, 'Verilog HDL Primer', BPB publications, 2000.

REFERENCE BOOKS:

1. Fundamental of Logic Design- Charles Roth Jr., Thomas Learning
2. Digital Logic Applications and principles- John Yarbrough, Pearson Education
3. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
4. A.Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

COURSE OUTCOMES:

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

- Summarize the concepts and process involved in digital circuits. [Understand]
- Model an optimized digital circuit by applying the knowledge of simplification methods, design procedure, PLDs and HDL. [Apply]
- Apply the concepts of PLDs and HDL to design and realize the digital circuits. [Apply]
- Analyze the performance characteristics of a digital circuit and derive its relationship between input and output. [Analyze]
- Design a digital circuit for the complex problem by using hardware /modern tool. [Create]
- Recommend a suitable digital circuit for a complex problem with a sustainable solution. [Evaluate]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3												
CO5			3		3									
CO6				2			2					1		

19UEE404 ELECTRIC POWER TRANSMISSION AND DISTRIBUTION

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the concepts of structure and restructure of electric power system
- To impart the knowledge on computation of transmission line parameters and modelling of transmission lines.
- To analyse the voltage distribution in insulator strings and cables and methods to improve the same.
- To understand the operation of different distribution schemes.

UNIT I INTRODUCTION TO ELECTRIC POWER SYSTEM 9+3

Evolution of Power System: Concepts of Structure and Restructure of electric power system, Bulk Power Grids and Micro-grids, Indian Power Scenario.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources.

Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies – EHVAC —Typical configurations, conductor types and electrical parameters of EHV lines.

UNIT II TRANSMISSION LINE PARAMETERS 9+3

Resistance, inductance and capacitance calculations: single and three phase transmission lines - double circuits -solid, stranded and bundled conductors - symmetrical and unsymmetrical spacing – transposition of lines – Concept and applications of GMR and GMD - skin and proximity effects.

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9+3

Classification of Transmission lines: short, medium and long lines – Equivalent circuit, phasor diagram, voltage regulation, line losses and transmission efficiency – real and reactive power flow in lines surge impedance and surge-impedance loading - Ferranti effect. Corona discharge characteristics – critical voltage and corona loss. Mechanical design of transmission line: Sag and tension calculations for different weather conditions.

UNIT IV INSULATORS AND UNDERGROUND CABLES 9+3

Insulators: Types - Characteristics and classification – voltage distribution and string efficiency of insulators - improvement of string efficiency - testing of insulators.

Underground Cables: constructional features of LT and HT cables – insulation resistance, Capacitance of single and 3 core belted cables and dielectric stress – grading of UG cables.

UNIT V DISTRIBUTION SYSTEM 9+3

Feeders, distributors and service mains. DC 2-wire distributor – radial and ring main distribution

systems. AC distribution - single phase and three phase, 4-wire distribution –Substation equipment and layout (AIS, GIS), concepts and methods of Grounding.

Total: 60 Periods

TEXT BOOKS:

1. D.P.Kothari , I.J. Nagarath, 'Power System Engineering', Tata McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCE BOOKS:

1. B.R.Gupta, S.Chand, 'Power System Analysis and Design'New Delhi, Fifth Edition, 2008.
2. Luces M.Fualkenberry Walter Coffer, 'Electrical Power Distribution and Transmission', PearsonEducation, 2007.
3. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
4. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.

COURSE OUTCOMES:

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

- Summarise the structure and parameters of power system (Understand)
- Compute the transmission line parameters, sag of an overhead transmission line and string
- efficiency of insulators.[Apply]
- Apply the concepts of power circle diagram and calculate the efficiency of underground cables. [Apply]
- Analyse the voltage distribution for the proper selection of insulator, strings, cables and tension calculation for different weather conditions. [Analyze]
- Evaluate the reliability, and critical performance of electric power systems and their components, incorporating advanced technologies like EHVAC, HVDC, and FACTS [Evaluate]
- Analyze the complexities of electric power systems by evaluating feeders and load distribution. (Analyze)

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3					2							
CO5				2								3		
CO6		3												

19UIT426	DATA STRUCTURE USING C (INTEGRATED COURSE)	L	T	P	C
		3	0	3	4.5

UNIT I LINEAR DATA STRUCUTRE – ARRAYS, LIST 10+10

Abstract Data Type – Approaches to design an Algorithm – Complexity – Arrays: Accessing Elements – Operations – List ADT: Memory Allocation and De-allocation – Singly linked lists – Circular linked lists – Doubly linked lists – Applications of lists – Polynomial Manipulation.

Experiments:

1. Program to implement Arrays.
2. Program to implement List ADT
3. Program to implement Polynomial Arithmetic using Linked List

UNIT II LINEAR DATA STRUCUTRE – STACK, QUEUE 10+10

Stack ADT: Array & Linked Representation – Applications of Stack – Balancing Parenthesis – Arithmetic expressions (Conversion & Evaluation) – Recursion - Queue ADT: Array & Linked Representation – Circular Queue – Applications of Queue.

Experiments:

1. Program to implement stack ADT using array and linked list
2. Program to implement stack and use it to Evaluate postfix expression
3. Program to implement queue ADT use array and linked list

UNIT III NON-LINEAR DATA STRUCUTRE – TREE 9+9

Introduction – Basic Terminology – Traversal – Operations: Binary trees – Expression Tree – Binary Search trees – AVL trees– B-trees. Heap: Binary Heaps – Applications of Heap

Experiments:

1. Program to implement binary search tree
2. Program to implement insertion and deletion in AVL trees
3. Program to implement priority queue using binary heaps

UNIT IV NON-LINEAR DATA STRUCTURE – GRAPH 8+8

Introduction – Graph Terminology – Representation of Graphs – Graph Traversal – Topological sort – Minimum Spanning Trees – Prim's and Kruskal's Algorithm – Shortest path algorithm – Dijkstra's algorithm – Floyd's Algorithm – Warshall's algorithm.

Experiments:

1. Program to implement Prim's algorithm using priority queues to find MST of an undirected graph
2. Program to implement Kruskal's algorithm using priority queues to find MST of an

undirected graph

UNIT V SEARCHING, SORTING AND HASHING 8+8

Searching: Linear Search – Binary Search, Sorting: Selection Sort – Bubble Sort – Insertion Sort – Merge sort – Quick sort – Hashing: Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

Experiments:

1. Program to implement searching technique.
2. Program to implement sorting technique.
3. Program to implement hashing technique.

Total: 60 Periods

TEXT BOOKS:

1. ReemaThareja, “Data Structures Using C”, Oxford University Press, Second Edition, 2014.
2. Weiss. M.A, "Data Structures and Algorithm Analysis in C", Pearson Education, 2nd Edition, 2012

REFERENCE BOOKS:

1. Aaron M.Tenenbaum, YedidyahLangsam, Moshe J.Augenstein, "Data Structures using C", Pearson Education India, 7th Edition, New Delhi, 2009.
2. Aho.V, Hopcroft.J.E, Ullman.J.D, "Data Structures and Algorithms", Pearson Education, 1st Edition Reprint, 2006.
3. Gilberg.R.F, Forouzan.B.A, "Data Structures", Thomson India Education, 2nd Edition, 2005.
4. Sara Baase and A.VanGelder, "Computer Algorithms", Pearson Education, 3rd Edition, 2005.
5. Cormen.T.H, C.A.Leiserson.B.A, R.L.Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2009.

COURSE OUTCOMES:

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

- Understand the various applications like linear and non-linear data structures to solve the problems in relevant applications [Understand]
- Apply the linear and non-linear data structures and sorting searching and hashing algorithms appropriately to solve variety of computational problems. [Apply]
- Analyze the different Program to implementations of various data structure algorithms and to calculate the efficiency of algorithms. [Analyze]

- Design and develop efficient linear, non-linear, sorting, searching and hashing data structure algorithms to solve problems.
- Evaluate the problems and find solutions using linear, non-linear applications, searching, sorting and hashing algorithms. [Evaluate]
- Select and apply appropriate data structures to design algorithms using modern tool. [Modern Tool Usage]

CO –PO MAPPING

COs	POs												PSOs	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3													
CO2	3													
CO3		3												
CO4			3						2	2				
CO5				3										
CO6					3				2	2				

19UEE406 ELECTRICAL MACHINES LABORATORY - II

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To acquire practical knowledge in determining regulation of synchronous machine, and the performance characteristics of synchronous & induction machines

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test
4. V and inverted V curves of three phase synchronous motor
5. Parallel operation of alternators
6. Load test on three-phase induction motor
7. Predetermination of performance characteristics of three-phase induction motor by circle diagram and equivalent circuit
8. Load test on single-phase induction motor
9. No load and blocked rotor tests on single-phase induction motor
10. Separation of no load losses in three phase squirrel cage induction motor.

Total: 30 Periods

COURSE OUTCOMES

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

- Compute the voltage regulation of alternators using different methods [Apply]
- Determine the performance characteristics of Induction motors. [Apply]
- Analyze the performance characteristics of AC Machines. [Analyze]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2	3													
CO3		3											3	
CO4									3	3				

19UEE407	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To impart knowledge on analysis and design of control system along with basics of Instrumentation

LIST OF EXPERIMENTS:

CONTROLSYSTEMS:

1. Determination of transfer function parameters of Armature controlled and Field controlled of DC (Servo) motor.
2. Determination of transfer function parameters of an AC servomotor.
3. Analog simulation of type-0 and type-1 systems
4. Digital simulation of first order and second order systems
5. DC and AC position control systems.
6. Stepper motor control system
7. Determination of transfer function parameters of DC generators.
8. Design of P, PI and PID controllers.

A minimum of FIVE experiments shall be offered

INSTRUMENTATION:

1. AC bridges.
2. DC bridges.
3. Instrumentation amplifiers.
4. A/D and D/A converters.
5. Measurement of iron loss.
6. Measurement of complex power with Trivector meter and verification

A minimum of FIVE experiments shall be offered

Total: 30 Periods

COURSE OUTCOMES:

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

- Determine the transfer function parameters of DC & AC servomotors and DC generator. [Apply]
- Analyze the transient response of type-0, type-1, first and second order systems for identifying the system behaviour. [Analyze]
- Examine the performance of different position control systems. [Apply]
- Compute the unknown values of R, L and C by using a suitable bridge circuit. [Apply]
- Compute iron loss using ring specimen and complex power using trivector meter. [Apply]
- Design and test the performance of instrumentation amplifier, A/D and D/A converters under various conditions. [Apply]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												
CO3	3													
CO4	3													
CO5	3													
CO6	3													

19UEE408	DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To realize adders, subtractors, flip flops
- To realize shift registers and counters.
- To assemble digital circuits using ICs and study the performance.

LIST OF EXPERIMENTS

1. Study of logic gates and verification of Boolean Laws.
2. Design of adders and subtractors
3. Design of Encoder and Decoder.
4. Design of code converters.
5. Design of Multiplexers and De-multiplexers.
6. Design of 2-bit and 8-bit magnitude comparators.
7. Study of flip-flops.
8. Design and implementation of counters using flip-flops.
9. Design and implementation of shift registers.
10. Design BCD to seven-segment display using 7447 IC
11. Mini Project.

Total: 30 Periods

COURSE OUTCOMES:

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

- Design and implement Combinational Circuits using logic gates [Create]
- Analyze and design sequential circuits using appropriate memory elements. [Create]
- Construct and verify combinational circuits using MSI devices. [Apply]
- Demonstrate proficiency in digital circuits by designing and implementing project based circuits. [Create]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												
CO3	3													
CO4			3							3				1

19UGS431	REASONING AND QUANTITATIVE APTITUDE	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To make the student acquire sound knowledge of the characteristic of quantitative and qualitative aptitude.
- To familiarize the student with various principles involved in solving mathematical problems.
- To develop an understanding of the basic concepts of reasoning skills.

UNIT I QUANTITATIVE APTITUDE 8

Ratio and Proportion - Averages – Percentages – Problems on ages – Profit and Loss – Simple and Compound Interest -– Time – Speed –Distance - Time and Work – Permutation and Combination - Alligation or Mixture – Probability – Clocks – Calendars.

UNIT II VERBAL AND NON VERBAL REASONING 7

Analytical Reasoning – Circular and Linear arrangement – Direction problems – Blood relations – Analogy – Odd Man Out – Venn Diagrams - Data Sufficiency – Data interpretation –– Syllogism - Coding – Decoding.

Total: 15 Periods

TEXT BOOKS:

1. Dr. R.S.Agarwal, “Quantitative Aptitude”, S. Chand Publications, New Delhi, 20th Edition, (2013).
2. Abijit Guha, “Quantitative Aptitude for Competitive Examinations”, Tata McGraw Hill Publication, New Delhi, 4th Edition, (2011).
3. R.V.Praveen, “Quantitative Aptitude and Reasoning”, PHI Learning Pvt. Ltd., Delhi, 2nd Edition, (2013).

REFERENCE BOOKS:

1. Ashish Aggarwal, “Quick Arithmetic”, S. Chand Publications, New Delhi, 6th Revised Edition, (2014).
2. Dr.V.A.Sathgurunath’S “A Guide for Campus Recruitment”, Sagarikka Publications, Thiruchirapalli, 3rd Edition, (2011).

WEBSITES:

www.m4maths.com, www.indiabix.com, www.fresherworld.com, www.campusgate.co.in, www.indianstudyhub.in, www.tcyonline.com.

COURSE OUTCOMES:

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

- Select an appropriate technique to solve the quantitative problems within the stipulated time. [Apply]
- Apply Verbal and Non Verbal Reasoning skills to solve the problems based on the logical and analytical reasoning. [Apply]
- Analyze the direction to solve equations involving one are more unknowns. [Analyze]

19UGM431	GENDER EQUALITY	L	T	P	C
		1	0	0	P/F

COURSE OBJECTIVES:

- To introduce basic concepts relating to gender and to provide logical understanding of gender roles.

UNIT I GENDER SENSITIZATION 5

Definition of gender, Perspectives-Gender sensitive approach- Gender and sex- Social construction of gender and gender roles- Socialization- institutions of socialization- changing content and context of gender-need for re-socialization. Gender Stereotyping and Gender Discrimination.

UNIT II GENDER EQUALITY AND CONSTITUTION 5

Indian constitution related to equality - Fundamental rights - Directive principles of state policy - right to equality - rights against exploitation - cultural and educational rights - the right to constitutional remedy - University Declaration of Human Rights - Enforcement of Human Rights for Women and Children - Role of Cells and Counselling Centres - Internal Complaints Committee - Legal AID cells, Help line, State and National level Commission.

UNIT III GENDER ROLES & EQUALITY 5

Gender & Morality–Structural and functionalist views of Gender- Gender in the Classroom-Beyond access for girls and boys-Gender equality in schools-Gender equality and adult basic education-Developing capacity to achieve gender equality in education-Individuality and removal of gender stereotypes- Respect for each other's-Promote equal Opportunity.

Total: 15 Periods

REFERENCE BOOKS:

1. Sheila Aikman and Elaine Unterhalter, "Practising Gender Equality in Education", Oxfam GB, 2007.
2. Pasadena and Hackensack, "Gender roles and Equality", Salem Press, 2011.

COURSE OUTCOMES:

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

- Describe the social construction of gender and sexuality and their influence in social context. [Understand]
- Analyze how the concepts of gender equality are created, maintained, and/or challenged. [Analyze]
- Apply concepts of gender roles and equality in classroom, school, disciplinary or interdisciplinary creative, scholarly, and/or activist project. [Apply]

19UEE501	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Different types of power switching devices and their static characteristics
- Operation, characteristics and performance parameters of phase controlled converters
- Operation and basics topologies of DC-DC Converters
- Different modulation techniques of pulse width modulated inverters
- Operation of AC voltage controller and various configurations.
- Applications of power electronic converters

Module 1 Power switching Devices 9

SCR, TRIAC, GTO, BJT, MOSFET, IGBT - Static characteristics;Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2 Phase controlled Converters 9

2-pulse, 3-pulse and 6-pulseconverters with R load and highly inductive load– performance parameters –Effect of source inductance–Dual converters; Applications-light dimmer, Solar PV systems

Module 3 DC-DC Converters 9

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage; power circuit of a buck, boost and Buck boost converter: analysis and waveforms at steady state; Introduction to resonant converters; Applications-Battery operated vehicles

Module 4 Inverters 9

Power circuit and operation of single and three phase voltage source inverter; instantaneous output voltage; Harmonic Control; PWM techniques: Single PWM, Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM; Introduction to space vector modulation; Current source inverter- ASCI; Applications-Induction heating, UPS.

Module 5 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: 45 Periods

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.
3. Ashfaq Ahmed ‘Power Electronics for Technology’, Pearson Education, Indian reprint, 2003.

REFERENCE BOOKS:

1. Joseph Vithayathil,’ Power Electronics, Principles and Applications’, McGraw Hill Series, 6th Reprint, 2013.
2. L. Umanand, “Power Electronics Essentials and Applications”, Wiley, 2010.
3. Ned Mohan Tore. M. Undel and, William. P. Robbins, ‘Power Electronics: Converters, Applications and Design’, John Wiley and sons, third edition, 2003.
4. S.Rama Reddy, ‘Fundamentals of Power Electronics’, Narosa Publications, 2014.
5. M.D. Singh and K.B. Khanchandani, “Power Electronics,” McGraw Hill India, 2013.

COURSE OUTCOMES:

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

- Explain the switching characteristics of various power-switching devices and their application in phase-controlled converters [Understand]
- Design the Converters and Inverters by applying various control strategies for a given practical application using Matlab. [Create]
- Sketch the input and output waveforms of power electronics converter under various load condition [Apply]
- Analyze the various performance parameters of Converters and Inverters with its standard values. [Analyze]
- Select appropriate power electronic converters and control strategies for specific applications, considering performance requirements, technological advancements and cost constraints. [Evaluate]

19UEE502	INTERNET OF THINGS FOR ELECTRICAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

-

Module 1 Introduction to IoT **9**

Internet of Things Architecture, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs, Introduction to Python, Introduction to different IoT tools.

Module 2 Sensors **9**

Sensors: Working Principles: Different types; Selection of Sensors for Practical ApplicationsDifferent Types of Sensors : Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc

Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor, Types- Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors.

Module 3 Actuators **9**

Electrical Actuation Systems, Electrical systems, Mechanical switches, Solid-state switches, Solenoids, D.C. Motors, A.C. Motors, Stepper motors.

Module 4 Building Iot With Raspberry Pi & Arduino **9**

Building IOT with RASPERRY PI- IOT Systems –Embedded computing logic-Microcontroller, system on chips –Arduino – Board details, IDE programming.

Module 5 Case Studies and Real-World Applications **9**

Case study: Study of Smart City and its Design - Applications - Industrial automation, smart grid, Smart Lighting, Smart Traffic Control, Electrical Vehicle Charging

Total: 45 Periods

TEXT BOOKS:

1. D. Patranabis, “Sensors and Transducers”, PHI Learning Private Limited.
2. W. Bolton, “Mechatronics”, Pearson Education Limited.
3. Simon Knight “Arduino for Beginners: Step-by-Step Guide to Arduino”
4. James R. Strickland “Raspberry Pi for Arduino Users” Published by APress 2018

REFERENCE BOOKS:

1. Patranabis, “Sensors and Actuators”, 2nd Edition, PHI, 2013.
2. Vijay Madisetti, ArshdeepBahga, “Internet of Things: A Hands-On Approach”

3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"

COURSE OUTCOMES:

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

- Understand the fundamental concepts, sensing techniques and actuation methods used in IoT applications for electrical automation. [Understand]
- Identify an IoT-based solutions using sensors, actuators, and microcontrollers for specific electrical automation tasks. [Apply]
- Analyze various IoT solutions using Raspberry Pi and Arduino platforms for electrical automation. [Analyze]
- Analyze the effectiveness and limitations of IoT applications in electrical automation. [Analyze]
- Evaluate the ethical, societal implications and adaptability of IoT system in electrical automation for sustainable development [Evaluate]
- Develop an electrical system using IoT for real world applications with the economical and resource considerations. [Create]

CO –PO MAPPING

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO1														
CO2	**3**													
CO3		**3**			**3**									
CO4		**3**												
CO5				**3**		**3**	**3**	**3**				**3**		
CO6			**3**		**3**						**3**			

19UEE503	MICROPROCESSOR AND MICROCONTROLLER PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students with the architecture and operation of typical microprocessors and microcontrollers.
- To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
- To provide strong foundation for designing real world applications using microprocessors and microcontrollers.
- To introduce Arduino and beagle boards

Unit I 8085 Microprocessor 9

Introduction and brief history of Microprocessors – Architecture of 8085 Microprocessor – CPU module – Bus Configuration of 8085 – Addressing Mode – Instruction format – Instruction set of 8085 Microprocessor – some basic examples – Subroutine & stack – Timing diagram.

Unit II 8051 Microcontroller 9

8051 Architecture – Pin details – Parallel Ports – Counters/Timers – Interrupts – Addressing modes – Instruction set of 8051 – Basic Assembly language Programming – Arithmetic operations, Code conversions, Sorting – Look up tables – Timer and serial port programming.

Unit III Peripheral Interface IC's 9

External Memory RAM, ROM Interface – Serial Communication (8251) – Parallel Communication (8255) – Programmable Keyboard and Display controller (8279) –UART (8250) - DMA Controller (8237) – ADC – DAC Interface to 8051.

Unit IV 8051 Embedded 'C' Programming 9

Introduction to IDE – Embedded C Data types – Programming structure – reading and writing data from/to parallel ports – Timer/Counter programming – Interrupt handling – Serial port programming.

Unit V Advanced microcontrollers 9

PIC 16F877 microcontroller – Architecture – On chip ADC – Capture/Compare/PWM Module – I2C – SPI – Watchdog timer – ARM7 (LPC2148) microcontroller – Architecture and applications.

Total: 45 Periods

TEXT BOOKS:

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, PIP Publication.
2. N.Senthil kumar, M.Saravanan, S.Jeevanandhan, "Microprocessors and Microcontrollers",

Oxford university press, 2010.

3. Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems”, second edition, By © 2005 Pearson Education, Inc.
4. Ajay V.Deshmukh, “Microcontrollers - Theory and applications”, Tata McGraw-Hill, publisher,2005.
5. Steve Furber, “ARM System-on-Chip Architecture”, Pearson Education, ISBN978-81- 317-0840-8, 2E, 2012.
6. John B.Peatman, “Design with PIC Microcontrollers”, Pearson Education, 2002.

REFERENCE BOOKS:

1. S K Mandal, “Microprocessors and Microcontrollers”, WBUT Series by Tata McGraw-Hill publisher.
2. Kenneth .J. Ayala, “The 8051 Microcontroller, Architecture, Programming & Applications”, Third edition, Penram International, India (2004).
3. P.S.Manoharan, P.S.Kannan, “Microcontroller based system design”, Scitech Publications Pvt. Ltd., Chennai, 2007.
4. Andrew N. Sloss, “ARM System Developer‟s guide”, ELSEVIER Publications, ISBN 978-81-8147-646-3, 2016
5. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2009.
6. http://www.nxp.com/documents/data_sheet/LPC2141_42_44_46_48.pdf

COURSE OUTCOMES:

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

- Illustrate the architecture, interfacing and programming concepts of Microprocessor and Microcontroller. [Understand]
- Develop an assembly language program for microprocessor and microcontroller based applications. [Apply]
- Select a suitable IC for peripheral interfacing with microprocessor for a given application. [Apply]
- Compare the requirements of a given application based on the features of suitable processor / controller and technological advancements for effective implementation of the system. [Analyze]

- Develop Microcontroller based system using C for real world applications with the economical and resource considerations. [Create] Select and use the Microcontroller with proper specifications for various applications. [Analyze]
- Make an effective communication and presentation in a team to demonstrate the concepts of Microprocessor and Microcontroller. [Affective Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4		3										3		
CO5			3		3						3			1
CO6									3	3				

19UEE507 **CREATIVE THINKING AND INNOVATION**

L	T	P	C
0	0	2	1

PREAMBLE:

Creativity is vital in nearly every industry and occupation. Creativity and innovation are key to generation of new ideas and methods of improving goods and services for customer satisfaction. This course enhances the creative thinking and innovation skills of the students. Being creative helps one to be a better problem solver in all areas of life and work.

COURSE OBJECTIVES:

- To develop next generation Entrepreneurs and Creative Leaders to resolve live challenges.
- To transform innovative ideas into successful businesses
- To use a range of creative thinking tools to develop Out of the Box Ideas

Course Content

Introduction to Creativity and Innovation- Creative Techniques - Problem Identification through Brain Storming - Solution Identification through Creative Techniques - Presentation on the Innovative Idea - Market Analysis - Revenue and Business Model - Preparation of promotional aids - Customer Feedback Analysis.

List of Activities:

Duration	What does the Faculty do?	What do the students do?
Week 1	Explains creativity and innovation	Team Formation (Team Size: 3)
Week 2	Explains the Creative Techniques (Through Video / Presentation)	Discovering Consumer Need through Need Analysis (Customer Segment)
Week 3	Facilitates the brain storming	Problem Identification through brain storming
Week 4	Facilitates problem solving	Identify the solution for the chosen problem through creative techniques
Week 5	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition

Week 6	Evaluates the presentation	Presentation on the Innovative Idea and Value Proposition
Week 7	Explains about the Market Research / Competitor Analysis, Revenue Model and Business Model	Market Analysis after the explanation
Week 8	Facilitates the students work	Preparation of Innovation Development Plan, Business Development Plan and Financial Plan
Week 9	Facilitates the students work	Preparing product promotional material
Week 10	Facilitates the students work	Improvement through Feedback

Total: 30 Periods

Assessment Pattern

1. Internal Assessment: Presentation on the Innovative Idea
2. End Semester Assessment:
    - Submission of Business Plan
    - Presentation on My Startup Idea (Evaluator : From Industry)

COURSE OUTCOMES

After successful completion of the course students will be able to:

- Demonstrate the ability to assess societal, health and safety issues and the consequent responsibilities relevant to the professional engineering practice (Valuing – Affective Domain)
- Examine impact on environment and society in the proposed innovative idea and provide solutions for sustainable development (Organization – Affective Domain)
- Adapt themselves to work in a group as a member or a leader for efficiently executing the given task (Organization – Affective Domain)

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1						3								
CO2				3			3							
CO3									3					

19UEE508	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate the performance and characteristics of power semiconductor devices, Phase controlled Converters , DC-DC Converters , inverters and AC to AC Converters

LIST OF EXPERIMENTS

1. Characteristics of SCR ,GTO and TRIAC
2. Characteristics of MOSFET and IGBT .
3. Transient characteristics of SCR and MOSFET
4. AC to DC fully controlled converter
5. AC to DC half-controlled converter
6. Step down and step up MOSFET based choppers
7. Resonant dc-to-dc converter
8. IGBT based single-phase PWM inverter
9. IGBT based three-phase PWM inverter
10. TRIAC based single phase AC voltage controller
11. TRIAC based single phase cyclo converters.
12. Simulation of Power electronic circuits using MATLAB
13. Study of battery charger, UPS and SMPS.

A minimum of TEN experiments shall be offered

Total: 30 Periods

COURSE OUTCOMES

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

- Examine the performance of converters, chopper and inverter circuits for different loads. [Analyze]
- Examine the performance of AC voltage controller and cyclo converters circuits for control of voltage. [Analyze]
- Design power electronic circuits using MATLAB - Simulink. [Analyze]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1		3												
CO2		3												
CO3			3		3									
CO4									3	3				
CO5		3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0				

19UEE509	MICROPROCESSOR AND MICROCONTROLLER PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To be familiar with the architecture and programming of microprocessor and Microcontrollers.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division using 8085.
2. Programming with control instructions:
   Ascending / Descending order, Maximum / Minimum of numbers
3. Programs using Rotate instructions
   Hex / ASCII / BCD code conversions.
4. Interface Experiments: with 8085
   A/D Interfacing. & D/A Interfacing.
   Traffic light controller.
5. Simple arithmetic operations: addition / subtraction / multiplication / division using 8051.
6. Read a key ,interface display
7. Interfacing of Stepper Motor.
8. Write embedded 'C' program to display your NAME in the first row of LCD and simultaneously 'ON' the first row of LEDs. After 10 seconds your REGISTER NUMBER to be displayed in the second row of LCD and simultaneously 'ON' the second row of LEDs. Draw the necessary flowchart.
9. Interface two seven segment LEDs with 8051 and develop embedded C program to display the numbers from 00 to 99in the LEDs.
10. Mini Project.

Total: 30 Periods

COURSE OUTCOMES

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

- Develop an assembly language program to interface A/D, D/A converters and traffic light controller with 8085. [Apply]
- Select an appropriate interface for the given application and implement it using 8085 / 8051. [Analyze]
- Develop an embedded C program for interfacing Matrix Keyboard, LCD, DAC, ADC and 7segment LED Display [Apply]
- Recommend a suitable solution for real time problems using microprocessor / microcontroller. [Evaluate]
- Develop an effective report and comprehend the technical skill as a team for the given

exercise. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													3
CO2		3												
CO3	3				3									3
CO4				3										

19UGS532	SOFT SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To develop a requisite knowledge in Communication skills and Soft skills.
- To enhance the students' acumen in honing the skills to meet the Global changes and Industrial needs.

Unit I Speaking Skills

Conversational Skills - Self Introduction - Group Discussion - Public Speaking - Presentation Skills

Unit II Writing Skills

Letter Writing – Report Writing – Email Writing – Job Application – Resume Preparation

Unit III Reading and Listening Skills

Reading Comprehension – Enriching Vocabulary – Error Spotting – Listening and Note Taking

Unit IV Soft skills

Professional Ethics – Interpersonal Skills – Stress Management – Leadership Qualities – Time Management – Conflict Resolution

Unit V Interview Skills

Types of Interview – Body Language – Professional Grooming – Basic Etiquette

Total: 45 Periods

COURSE OUTCOMES:

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

- CO – 1: Students will give oral presentations and improve their reading fluency skills through extensive reading and listening.
- CO – 2: Students will increase their reading speed and comprehension of academic articles by enhancing their vocabulary by keeping a vocabulary journal.
- CO – 3 Students will strengthen their ability to write academic papers, essays, official documents and summaries using the process approach.
- CO – 4: Students will be aware of correct usage of English grammar and develop in writing skills, speaking fluently and comprehend properly

19UEE601 ELECTRIC DRIVES AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To study the Steady state operation and transient dynamics of a motor load system.
- To Analyze the operation of the converter/chopper fed dc drives
- To Analyze the Operation and performance of AC motor drives.
- To impart knowledge on design of current and speed controllers for a closed loop solid state dc motor drive
- To explain the operation of the converter / chopper fed dc drive and ac drive

UNIT I DRIVE CHARACTERISTICS 9

Introduction to Electric drives – Equations governing motor load dynamics – steady state stability – multi quadrant operation-Modes of operation: acceleration, deceleration, starting & stopping – typical load torque characteristics – Classes of duty and ratings-Selection of motor.

UNIT II CONVERTER / CHOPPER FED DCMOTORDRIVE 9

Steady state analysis of the single and three phase converter fed separately excited DC motor drive– continuous conduction – Time ratio and current limit control – 4 quadrant operation of converter / chopper fed drive-Applications, Microcontroller based control of DC motor drives.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control–V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-- voltage/current source inverter fed AC drives- Cycloconverter fed IM drives-closed loop control—— vector control

UNIT IV SYNCHRONOUS MOTORDRIVES 9

V/f control and self-control of synchronous motor: Constant Margin angle control and ower factor control- Three phase voltage/current source fed synchronous motor drive- Cycloconveter fed synchronous motor drive- Applications.

UNIT V DESIGN OF CONTROLLERSFOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode – Design of controllers; current controller and speed controller- converter selection and characteristics.

Total: 45 Periods

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House,Reprint 2019.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education,2002.

3. Vedam Subramanyam, " Electric Drives Concepts and Applications ", 2e, McGraw Hill,2016.

REFERENCE BOOKS:

1. Krishnan R, " Electric Motor & Drives Modeling, Analysis and Control ", Prentice Hall of India,2001 Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
2. N.K. De., P.K. SEN" Electric drives" PHI,2012.
3. Eclayton A. and NNHancock,, "The performance and Design of Direct current Machines",CBS & Distributors Pvt.Ltd, 2004.

COURSE OUTCOMES:

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

- Illustrate the steady state operation and transient dynamics of a motor load system [Understand]
- Determine the performance parameters of DC / AC Drives under different load conditions. [Apply]
- Analyze the operation of the converter/chopper fed dc drive [Analyze]
- Analyze the performance of converter/inverter fed induction motor drives for industrial applications. [Analyze]
- Design the current and speed controllers for a closed loop solid state DC motor drive.[Create]
- Communicate effectively the significance, social impact and future perspects of DC / AC motor drives in various applications. [Valuing – Affective Domain]

CO – PO MAPPING

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO 1														
CO 2	3												3	
CO 3		3												3
CO 4		3												3
CO 5			2		3									
CO 6						3				3		3		

19UEE602 **POWER SYSTEM ANALYSIS**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To model various power system components and carry out load flow, short circuit and stability studies

PREREQUISITE: Linear Algebra, Partial Differential Equations, Knowledge in circuit theory, Transmission and Distribution

Module 1 INTRODUCTION **9+3**

Structure and restructure of Power system - Electricity market entities and model- Benefits of deregulation- Basic Components of a power system and its modelling - Single line diagram – Impedance diagram – Reactance diagram - Per Phase Analysis -Per unit system - Simple bus building algorithms for the formation of Y-Bus matrix – Applications of Power System Analysis.

Module 2 POWER FLOW ANALYSIS **9+3**

Importance of power flow analysis in planning and operation of power systems-Statement of power flow problem – Bus Classifications – power flow solution methods - Gauss Seidal method - Newton Raphson method (polar form) - Fast decoupled method – Comparison of all the methods.

Module 3 SYMMETRICAL FAULT ANALYSIS **9+3**

Need of short circuit analysis - Symmetrical three phase fault- Short circuit capacity- Bus building algorithm for the formulation of Z – Bus matrix - systematic fault analysis using bus impedance matrix.

Module 4 UNSYMMETRICAL FAULT ANALYSIS **9+3**

Introduction to symmetrical components – sequence impedances – sequence networks representation of single line to ground fault, line to line fault and Double line to ground fault.

Module 5 POWER SYSTEM STABILITY ANALYSIS **9+3**

Importance of stability analysis in power system planning and operation – Types of stability - Basic concepts and definitions – Rotor angle stability - Swing equation- Solution of swing equation by step by step method – An elementary view of transient stability – Equal area criterion – critical clearing angle and time- Numerical integration methods (Algorithm and flow chart) for multi-machine stability analysis – Euler method – modified Euler method – Real time stability analysis – Introduction to Advanced Power System Analysis.

Total: 60 Periods

TEXT BOOKS:

1. John J. Grainger and W.D. Stevenson Jr., “Power System Analysis”, McGraw Hill International Book Company, 1st Edition, 2003.
2. Nagrath I.J. and Kothari D.P., “Modern Power System Analysis”, McGraw-Hill Publishing Company, New Delhi, 2011.
3. Hadi Saadat, “Power System Analysis”, McGraw Hill Publishing Company, New Delhi, 2002.
4. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, “Electrical Power Systems: Analysis, Security and Deregulation” Prentice Hall India (PHI), second edition - 2017.

REFERENCE BOOKS:

1. Wadhwa C L, "Electrical Power Systems", New Age International Publishers, Delhi, 2006 Fourth Edition Reprint Aug, 2007.
2. Kundur P., “Power System Stability and Control”, McGraw Hill, Publications, 2013
3. Olle. I. Elgerd, “Electric Energy Systems Theory – An Introduction”, McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2013.
4. Pai M.A., “Computer Techniques in Power System Analysis”, McGraw – Hill Publishing Company, New Delhi, 2003.
5. Gupta B.R., “Power System Analysis and Design”, S. Chand, New Delhi, 2003.

COURSE OUTCOMES:

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

- Understand the structure and restructuring of power system and need of load flow analysis, short circuit analysis and stability analysis. (Understand)
- Use simulation tools to perform comprehensive load flow studies, short circuit studies and stability studies.(Apply)
- Develop reactance diagram of given power system. [Apply]
- Analyse a power system network under symmetrical and unsymmetrical fault condition and interpret the results of the analysis.(Analyse)
- Analyse the transient behaviour of power system when it is subjected to a fault (Analyse).
- Choose appropriate numerical methods to solve the power flow problem by interpreting its results. (Evaluate)

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3				3									
CO3	3													
CO4		3												
CO5		3				2								
CO6				3										

19UEC621	DIGITAL SIGNAL PROCESSING FOR ELECTRICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basic concept of signals and systems
- To explain the different transform techniques to analyze the discrete time systems
- To provide a thorough understanding of the design techniques for digital filters and digital signal processors

UNIT I INTRODUCTION TO SIGNALS AND SYSTEMS 9

Classification of systems: Continuous, discrete, linear, causal, stable, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; Operation on signals. spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution - Analysis of LTI Systems in z-domain.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 9

DFT properties, magnitude and phase representation - Computation of DFT using FFT algorithm –DIT & DIF - FFT using radix 2 – Butterfly structure – Application of DSP in power quality analysis.

UNIT IV DESIGN OF DIGITAL FILTERS 9

FIR design: Windowing Techniques (Rectangular, Hamming, Hanning window only)s – Need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – Butterworth and Chebyshev approximations; digital design using impulse invariant and bilinear transformation -Warping, prewarping - Frequency transformation.

UNIT V DIGITAL SIGNAL PROCESSORS 9

Introduction– Architecture – Features – Instruction sets – Addressing Formats – Functional modes – Introduction to commercial Digital Processor – TMS320C5X – TMS320C54X - Simple Programs.

Total: 45 Periods

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, “Digital Signal Processing Principles, Algorithms and Applications” , Pearson Education, New Delhi, 2010.

2. S.K. Mitra, “Digital Signal Processing – A Computer Based Approach” , Tata McGraw Hill, New Delhi 2013

REFERENCE BOOKS:

1. Alan V. Oppenheim, Ronald W. Schafer,“Discrete time signal processing” Third Edition, 2010.
2. E.C. Ifeachor and B.W. Jervis, “Digital signal processing – A practical approach” Fourth Edition, 2007.
3. S. Salivahanan, A. Vallavaraj And C. Gnanapriya, “Digital Signal Processing” First Edition, Tata McGraw Hill, New Delhi 2008
4. B.Venkataramani, M.Bhaskar “ Digital Signal Processors: Architecture Programming and Application”, Tata McGraw Hill, 2011.

COURSE OUTCOMES:

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

- Describe the functions and fundamental concepts of DT signals and systems and processors**. (K2- Understand)**
- Apply Engineering knowledge and FFT algorithms to classify DT signals and system and efficient computation of DFT. [**K3 - Apply**]
- Apply appropriate engineering knowledge to design digital filters and DSP processors to develop programs. [**K3-Apply**]
- Apply Z transform and various transformation techniques to analyze DT systems and digital filters [**K4- Analyze]**
- Evaluate DT system response of a system using Z-transform, DFT and Digital filters [**K5-Evaluate]**
- Develop various DSP algorithms for real time applications. [**K6-Create**]

19UEE607 **PRODUCT DEVELOPMENT PROJECT**

L	T	P	C
0	0	8	4

COURSE OBJECTIVES:

- To deepen comprehension of principles by applying them to new technical problems which may be the design, and research investigation of electrical and electronic systems.
- To perform literature survey on recent developments in a selected problem domain.
- To exercise various strategies to find a solution addressing the problem.
- To communicate the work done in written and oral forms.
- To develop a prototype model.

Total: 120 Periods

COURSE OUTCOMES

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

- Identify and formulate the real world problem (Understand)
- Articulate and conceptualize the methodology of the project (Apply)
- Categorize the proper components as per requirements of the design/system (Analyze)
- Apply the new tools, algorithms, methodologies that contribute to obtain the solution of the projec (Analyze)
- Design and execute the project using modern tools and demonstrate the working of the mode (Create)
- Defend the findings and execute the project with written reports and developed product (Evaluate)

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3													
CO2		3												
CO3		3									3			
CO4	3		1		3									
CO5			3		3									
CO6				3					3	3				

19UEE608	ELECTRIC DRIVES AND CONTROL LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To impart knowledge on design of current and speed controllers for a closed loop solid state dc motor drive

LIST OF EXPERIMENTS

1. Simulation of Single Phase Fully Controlled Converter fed DC motor Drive
2. IGBT Chopper Fed DC motor Drive
3. IGBT based Three phase PWM Inverter Fed AC motor Drive
4. Simulation of Three Phase Fully Controlled Converter fed DC motor Drive
5. Simulation of speed of converter/chopper fed DC motor drive
6. Simulation of speed control of VSI fed three-phase induction motor.
7. Micro controller based speed control of Stepper motor.
8. Simulation of speed control of DC motor.
9. Modeling and simulation of Induction Motor using MATLAB
10. Simulation of Single phase AC Voltage Controller fed AC motor drive.
11. DSP based speed control of BLDC motor.
12. Modeling and simulation of Induction Generator using MATLAB

Total: 30 Periods

COURSE OUTCOMES

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

- Simulate the converter fed DC & AC Drives circuits for various control strategies. [Apply]
- Analyze the performance of converter fed DC drives for industrial applications [Analyze]
- Analyze the performance of inverter fed AC drives for industrial applications [Analyze]
- Design closed loop controllers for solid state drives. [Create]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3				3									
CO2		3												
CO3		3												
CO4			3											
CO5									3	3				

19UGS633	INTERPERSONAL SKILLS LABORATORY	L	T	P	C
		0	0	3	1.5

List of Exercises

Part - A : Communication and Leadership Projects

I) Speech Projects

1. The Open up Speech (Prepared Speech)
2. Speech Organizing to the Point (Prepared Speech)
3. Table Topics Speech

II) Evaluation Projects

4. Speech Evaluation
5. TAG (Timer, Ah Counter and Grammarian) Evaluation

III) Leadership Roles

6. Speech Master of the Day
7. General Evaluator
8. Table Topics Master

Part - B : Problem-Solving and Decision- Making Project

IV) Quality Circle Project

Total: 45 Periods

COURSE OUTCOMES

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

- Communicate orally with fluency and clarity in a given contextual situation (Responding - Affective Domain)
- Evaluate a speech and offer constructive evaluation of the speech (Evaluating - Cognitive Domain)
- Adapt themselves to work in a group as a member or a leader for efficiently executing the given task (Organization – Affective Domain)
- Analyze a problem and find appropriate solution (Analyze - Cognitive Domain)
- Take decision by organizing relevant information and defining alternatives (Create - Cognitive Domain)

19UGM631	INDIAN CONSTITUTION	L	T	P	C
		1	0	0	P/F

COURSE OBJECTIVES:

- The students will be exposed to fundamental rights & duties in Indian Constitution.
- The students will be given knowledge on the components of the parliamentary system to prepare for the process of their career development.
- The student will have knowledge on powers and functions of Local bodies and Indian polity to appear for various competitive exams such as UPSC, TNPSC and RRB.
- The student will know about the functions of judiciary and electoral process followed in the country.

UNIT I INTRODUCTION ON INDIAN CONSTITUTION 4

Preamble - Salient features of the Constitution of India. Fundamental Rights - its restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) - Fundamental Duties: its Scope and significance in Nation building - Constitution components: schedule, parts and articles of constitution- important Amendments of constitution.

UNIT II PARLIAMENTARY SYSTEM 4

Parliamentary System – parliamentary system of other countries - Indian parliamentary system-Federal System – LS and RS, Centre-State Relations-Election of member of parliaments- Union Executive - President, Prime Minister, Union Cabinet. State Legislature - State Executives –election of MLA- Governor, Chief Minister, State Cabinet.

UNIT III JUDICIARY AND ELECTION COMMISSION 4

Supreme Court of India: Structure, Power and Functions of Supreme Court-- Judicial Reviews - Judicial Activism. High Court and Subordinate Courts: Structure, Power and Functions. – Lok adhalats. Elections- Electoral Process - Election Commission of India - Election Laws – Emergency Provisions - types of Emergencies and its consequences.

UNIT IV LOCAL ADMINISTRATION 3

Local Administration: Powers and functions of Municipalities and Panchayats System- Panchayat Raj- Co–operative Societies and Constitutional and Non-constitutional Bodies.

Total: 30 Periods

TEXT BOOKS:

1) Shubham Singles, Charles E. Haries, et al., “Constitution of India and Professional Ethics” by Cengage Learning India Private Limited, 2018.

2) Subhash C. Kashyap,"Our Constitution: An Introduction to India's Constitution and constitutional Law", NBT, 2018.
3) Brij Kishore Sharma,"Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.
4) M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5) Durga Das Basu, "Introduction to the Constitution on India", Prentice Hall, 2001.

COURSE OUTCOMES:

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

- Apply knowledge of the fundamental rights and duties prescribed by Indian Constitution to prepare for various competitive examinations.
- Manage complex societal issues in society with the knowledge of judiciary and local administration.
- Interpret the societal, health, safety, legal and cultural issues with understanding of parliamentary system and electoral process through self-learning skills.
- Understand the ethical responsibilities of municipalities, panchayats and co-operative societies.
- Understand and distinguish the functioning of the parliamentary system followed in various countries.

19UME701	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge to find solutions and approaches for various projects.
- To familiarize the utilization of project within time, resource and financial constraints.

UNIT I PROJECT MANAGEMENT CONCEPTS 9

Concept and characteristics of a project, importance of project management, types of project, project organizational structure, project life cycle, Statement of Work, Work Breakdown Structure.

UNIT II PROJECT PLANNING 9

Project Planning and Scheduling techniques - developing the project network using CPM/PERT, Limitations of CPM/PERT, Precedence Diagramming Method, constructing diagram and computations using precedence diagramming method, PERT/CPM simulation, reducing project duration.

UNIT III RESOURCE SCHEDULING & CRITICAL CHAIN SCHEDULING 9

Resource Scheduling - Resource allocation method, splitting and multitasking, Multi project resources scheduling - Critical Chain Scheduling -Concept of critical chain scheduling - critical chain scheduling method, application of Critical chain scheduling and limitations.

UNIT IV PROJECT QUALITY MANAGEMENT 9

Concept of project quality, responsibility for quality in projects, quality management at different stages of project, tools and techniques, Quality Management Systems, TQM in projects - Project Performance Measurement and Control - Monitor and assess project performance, schedule, and cost. Earned Value Management, performance measurement methods to monitor, evaluate and control planned cost and schedule performance - Project Closure/ Termination - Meaning of closure/ termination, project audit process, termination steps, final closure.

UNIT V FINANCIAL ACCOUNTING 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis – Comparative financial statements. Investments - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

Total: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be:

1. Describe the concept and characteristics of project management and application of resource scheduling and critical chain scheduling. (Understand)
2. Estimate the suitable resources required for given project work (Apply)
3. Construct the balance sheet to identify the fund flow and cash flow statements (Apply)
4. Apply the concept of CPM and PERT to develop the project network (Apply)
5. Examine the various tools and techniques at different stages of Quality management. (Analysis)
6. Evaluate the decision related to fore casting, inventory, quality control problems etc. for the industries (Evaluate)

TEXT BOOKS:

1. Prasanna Chandra, "'Fundamentals of Financial Management' ", Tata Mcgraw-Hill Publishing Ltd. 2015.
2. Jack Meredith, Samuel J.Mantel, "Project Management- A Managerial Approach", John Wiley andSons.

REFERENCE BOOKS:

1. Clifford F Gray, Erik W Larson, "Project Management-The Managerial Process ", Tata Mcgraw-Hill Publishing Co Ltd.
2. John M Nicholas, "Project Management For Business And Technology", Prentice Hall of India Pvt Ltd.
3. Paresh Shah, "Basic Financial Accounting for Management", Oxford University Press, 2020.

COURSE ARTICULATION MATRIX:

CO/PO/PSO MAPPING

CO	POs												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO.1											**3**				
CO.2											**3**				
CO.3											**3**				
CO.4											**3**				
CO.5		**3**													
CO.6				**3**			**3**								
19UME701											**3**				

Ref: 3 - Strong 2 - Medium 1 – Weak

19UEE702 **ELECTRIC VEHICLES**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Electric and Hybrid Vehicles
- To apply the operation of DC and Induction motors to electric vehicles and hybrid electric vehicles
- To categorize energy storage devices for electric vehicles
- To explore design methodologies for electric vehicle systems

UNIT I INTRODUCTION TO ELECTRIC VEHICLES AND VEHICLE DYNAMICS 9

Introduction, Benefits and Challenges History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles Conventional Vehicles- Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance. Power flow control of various hybrid drive-train configurations.

UNIT II ELECTRIC PROPULSION UNIT 9

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of Brushless DC Motor drives, Configuration and control of Induction Motor drives Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, drive system efficiency.

UNIT III ENERGY STORAGE SYSTEMS 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Battery and ultra-capacitor technologies, vehicle integration, and performance characteristics, Hybridization of different energy storage devices,Selecting the energy storage technology.

UNIT IV ENERGY MANAGEMENT STRATEGIES 9

Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies.

UNIT V COMMUNICATIONS, SUPPORTING SUBSYSTEMS 9

In vehicle networks- CAN, Plug-in electric vehicles, Vehicle to grid (V2G) and G2V fundamentals, Business- E- mobility business, Electrification challenges Case Studies(Nissan, Tesla, Toyota): Design of a Hybrid Electric Vehicle (HEV) and software challenges ,E- mobility Indian Road map perspective.

Total: 45 Periods

TEXT BOOKS:

1. MehrdadEhsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003

3. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011

REFERENCE BOOKS:

1. Hybrid Vehicles and the future of personal transportation, Allen Fuhs, CRC Press, 2011.

2. Vehicle Power Management: Modeling, Control and Optimization, Xi Zhang, Chris Mi, Springer, 2011.

COURSE OUTCOMES:

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

- Explain the social and environmental impact of Electric and Hybrid vehicles in the society [Understand]
- Compute the sizing requirements of power train components utilized in Electric and Hybrid vehicles [Apply]
- Compare the conventional and recent methods of Energy Management / Storage techniques in the development of Electric Vehicle Technology [Analyze]
- Examine the performance standards of Electric and Hybrid vehicles [Analyse]
- Design the electric propulsion unit and its control for the application of electric vehicles with environmental consideration using locally procured hardware components. [Create]
- Communicate effectively to propagate ideas to the engineering community and promote teamwork. [Affective Domain - Valuing]

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2	**3**											
CO3		**1**										**3**
CO4				**3**		**3**	**3**					
CO5			**3**				**3**				**3**	
CO6									**3**	**3**		

19UEE703 ELECTRIC ENERGY UTILIZATION AND CONSERVATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To explain the application of electric drives and concept of traction.

To design the optimal illumination system by using various types of lamps.

To choose the correct electric heating and electric welding method for a particular application.

To familiarize with the operation of various domestic appliances and the need of energy efficiency.

To impart the knowledge on refrigeration, air-conditioning and tariff.

Unit I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - Merits of electric traction – requirements of electric traction system – supply systems - tractive effort calculations and speed-time characteristics - electric braking - traction motor control - recent trends in electric traction.

Unit II ILLUMINATION 9

Importance of lighting – properties of good lighting scheme – terminology - laws of illumination – photometry - 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 III HEATING AND WELDING 9

Introduction - modes of heat transfer - advantages of electric heating – types of electric heating and applications - Electric furnaces - Resistance, inductance and Arc Furnaces - Types of electric welding and applications - resistance welding - arc welding - power supply for arc welding - radiation welding.

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 DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9

House wiring. Induction based appliances, Online and OFF line UPS, Batteries - Power

quality aspects – nonlinear and domestic loads – Earthing – Domestic, Industrial and Substation - Cost of electrical energy - Depreciation and determination methods - tariff - economics of power factor correction.

Total: 45 Periods

TEXT BOOKS:

1. Suryanarayana N.V., "Utilization of Electric Power", Wiley Eastern Limited, New Age International Limited, 1994.
2. Gupta J.B, "Utilization Electric power and Electric Traction", S.K.Kataria and Sons, 2009.
3. G. C. Garg, "Utilization of Electric Power & Electric Traction" Khanna Publishers, New Delhi.
4. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010

REFERENCE BOOKS:

1. Rajput R.K., "Utilisation of Electric Power", Laxmi publications Private Limited., 2007.
2. Partab H., "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2004.
3. Wadhwa C.L., "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt.Ltd., 2003.
4. Sivanagaraju S., Balasubba Reddy M. and D. Srilatha, "Generation and Utilization of Electrical Energy", Pearson Education, 2010.
5. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

COURSE OUTCOMES:

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

- Explain the concepts of electric energy utilization. [Understand]
- Apply the knowledge of electrical equipment and appliances for industrial and domestic applications. [**Apply**]
- Analyze the importance of observing energy efficient measures and power factor improvement practices. [**Analyze**]
- Estimate the appropriate sizing of refrigeration and air-conditioning systems with the consideration of environmental aspects. [**Evaluate**]
- Design a suitable illumination and UPS systems for a given location by considering safety issues. [**Create**]
- Discover the possibilities of recent trends in electric energy utilization for achieving a sustainable development. [**Analyze**]

CO – PO MAPPING

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO.1	3					2							3	
CO.2		3						2						
CO.3				3			2							
CO.4			3			3								3
CO.5		3					3					2		
CO.6	3					2							3	

19UEE704	PROTECTION AND SWITCH GEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the characteristics and functions of relays and protection schemes
- To impart knowledge on apparatus protection and functioning of circuit breakers
- To introduce static and numerical relays

Unit I PROTECTION SCHEMES 9

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes.

Unit II ELECTROMAGNETIC RELAYS 9

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

Unit III APPARATUS PROTECTION 9

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

Unit IV STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators– Block diagram of Numerical relays – Over current protection, transformer differential protection and distant protection of transmission lines.

Unit V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping -interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers. Intelligent Circuit Breakers.

Total: 45 Periods

TEXT BOOKS:

1. Sunil S.Rao, “Switch gear and Protection”, Khanna Publishers, New Delhi, 2008.
2. Rabindranath B. and Chander N., “Power System Protection and Switchgear”, New Age International (P) Ltd., First Edition 2011.
3. Soni M.L., Gupta P.V., Bhatnagar U.S. and Chakrabarti A., “A Text Book on Power System Engineering”, Dhanpat Rai& Co.,1998.

REFERENCE BOOKS:

1. BadriRam B.H. Vishwakarma, “Power System Protection and Switchgear”, New Age International Pvt Ltd Publishers, Second Edition, 2011.

2. Paithankar Y.G. and Bhide S.R., “Fundamentals of power system protection”, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

3. Wadhwa C.L., “Electrical Power Systems”, 6th Edition, New Age International (P) Ltd., 2010

4. Ravindra P.Singh, “Switchgear and Power System Protection”, PHI Learning Private Ltd., NewDelhi, 2009.

5. BhaveshBhalja, Maheshwari R.P. and Nilesh G. Chotani, “Protection and Switchgear”, Oxford University Press, 2011.

COURSE OUTCOMES:

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

- Explain the functions of protective schemes and switchgears used in the power system [Understand]
- Compute the performance parameters of power system protection under different scenarios. [Apply]
- Choose a suitable static and numerical relays for power system protection. [Apply]
- Analyze different types of faults that occured in high power generator and transformers to identify suitable protective scheme for the safe functioning of industry / soceity. [Analyze]
- Analyze the functions of Circuit breaker for the given condition. [Analyze]
- Make an effective communication and presentation in a team to demonstrate the concepts of Electromagnetic relays and circuit breakers. [Affective Domain]

CO - PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2	**3**											
CO3	**3**											
CO4		**3**				**3**						
CO5		**3**										
CO6									**3**	**3**		

19UEE708 POWER SYSTEM SIMULATION LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To familiarize with the digital simulation of power system problems

LIST OF EXPERIMENTS

1. Computation of Parameters and Modeling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method.
4. Load Flow Analysis - II: Solution of Load Flow and Related Problems using Newton-Raphson and Fast- Decoupled Methods
5. Fault Analysis.
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Electromagnetic Transients in Power Systems
8. Analysis of System Load Variations.
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

Total: 30 Periods

COURSE OUTCOMES

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

- Compute the parameters & modelling of Transmission Line and formation of Bus Admittance & Impedance Matrices. [Apply]
- Compute the fault current under balanced and unbalanced conditions. [Apply]
- Analyze the steady state and transient stability of SMIB and multi machine system for power system planning and operation. [Analyze]
- Analyze the load frequency control of single area and two area system for maintaining the system frequency in power system. [Analyze]
- Compute the solution for economic dispatch problem in power system. [Apply]
- Choose appropriate numerical methods to solve the power flow problem by interpreting its results. (Evaluate)

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3				3									
CO2	3				3									
CO3		3			3									
CO4		3			3									
CO5	3				3									
CO6				3	3									

19UEE709	RENEWABLE ENERGY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To train the students in Renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and possible future role of Renewable energy sources.

LIST OF EXPERIMENTS

1. Simulation study on Solar PV Energy System.
2. Experiment on “VI-Characteristics and Efficiency of 1kWp Solar PV System”.
3. Experiment on “Shadowing effect & diode based solution in 1kWp Solar PV System”.
4. Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
5. Simulation study on Wind Energy Generator.
6. Experiment on Performance assessment of micro Wind Energy Generator.
7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9. Experiment on Performance Assessment of 100W Fuel Cell.

Total: 30 Periods

COURSE OUTCOMES

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

- Understand and analyze Renewable energy systems.
- Apply the knowledge of Renewable Energy technologies for sustainable Energy development. [Apply]
- Analyze the operation and performance characteristics of Renewable Enegy Systems. [Analyze]
- Compare the performance of conventional and recent technologies in renewable energy system. [Analyze]
- Develop an effective report and comprehend the technical skill as a team for the given exercise. [Psychomotor Domain.

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1					3									3
CO2	3				3		3							3
CO3					3		3							3
CO4		3			3							3		
CO5									3	3				

19UGM731	PROFESSIONAL ETHICS & HUMAN VALUES	L	T	P	C
		2	0	0	P/F

OBJECTIVES :

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others

UNIT I HUMAN VALUES 7

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 7

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 4

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 6

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 6

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

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

1. Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
2. 2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
4. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011.

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1								3						

		L	T	P	C
19UEE803	**PROJECT WORK**	**0**	**0**	**16**	**8**

OBJECTIVES

To deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer based project or management project.

PROJECT DESCRIPTION

Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project. The progress of the project is evaluated based on a minimum of three reviews.

TOTAL : 360 PERIODS

COURSE OUTCOMES:

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

1. Design/Develop sustainable solutions for societal issues with environmental considerations by applying the basic engineering knowledge. [Create]
2. Analyze and review research literature to synthesize research methods including design of experiments to provide valid conclusion. [Analyze]
3. Utilize the new tools, algorithms, techniques to provide valid conclusion following the norms of engineering practice. [Apply]
4. Test and Evaluate the performance of the developed solution using appropriate techniques and tools. [Evaluate]
5. Apply management principles to function effectively in the project team for project execution. [Affective Domain]
6. Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs. [Affective Domain]
7. Write effective reports and make clear presentation to the engineering community and society. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		3				3						3	3
CO2		3		3									3	3
CO3					3			3					3	3
CO4		3			3								3	3
CO5									3		3			
CO6						3	3					3		
CO7										3				

19UEE901	NETWORK ANALYSIS AND SYNTHESIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To analyse the relationship between various two port parameters, ladder and lattice networks.
- To analyse the transients in electrical networks with DC and AC excitation
- To synthesise RL, RC & RLC networks by Foster and Cauer form
- To design different types of passive filters.

Unit I Introduction to Graph Theory 9

Linear Graphs in Electrical Networks, Basic Definitions, Incidence, Loop and cut-set matrices, Fundamental Loop and Fundamental Cut-Set Matrices, Graph Theoretic version of KCL and KVL,Loop Impedance and Node Admittance Matrices, Duality in Electrical Networks.

Unit II Two Port Network 9

Network functions - Poles and Zeros of network functions - Complex frequency - Two port parameters Z,Y,H and ABCD - Scaling network functions -T and π equivalent circuits - Bridged networks - Analysis of ladder and lattice networks - Coupled circuits as two port network – Tuned circuits.

Unit III Transient Response of RLC Circuits 9

Transient response of RL,RC,RLC, circuit for DC input and AC input with sinusoidal excitation.

Unit IV Transfer Function Synthesis 9

Properties of LC,RL,RC driving point functions, Synthesis of driving point LC,RC and RL functions- Foster and Cauer forms- Synthesis of transfer admittance, transfer impedance with a one ohm termination - Synthesis of constant-resistance network.

Unit V Design of Filter 9

Design of filters -Low pass filters, high pass filters, band pass filters, band reject filters, Butterworth filters, m-derived filters, constant k-filters

Total: 45 Periods

TEXT BOOKS:

1. Franklin F.Kuo**,** “Network Analysis and Synthesis (5th Edition ,2012)” Wiley International;2010

2. Andreas Antoniou,” Digital filters (Analysis, Design and Application)”, McGraw-Hill; 2nd edition (May 15, 2000)

REFERENCE BOOKS:

1. M.E.Van Valkenberg, “Introduction to Modern Network Synthesis”, *Wiley Eastern.*

2. Umesh Sinha “Network Analysis and Synthesis”Satya Prakashan Publishers , 4th Edition 2013

3. David A Bell,"Electric Circuits Oxford Press, ", (7thEdition, 2011).

COURSE OUTCOMES:

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

- Analyse various electrical networks in steady & transient states. [Analyze]
- Analyze the various network topologies [Analyze]
- Apply S-domain analysis to get network parameters [Apply]
- Analyze the elements of network synthesis [Analyze]
- Design various types of filters. [Create]

19UEE902 HIGH VOLTAGE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on over voltages, protection schemes, breakdown mechanism and measurement of over voltages in power system
- To familiarize about the various testing methods of power apparatus

Unit I Over Voltages in Electrical Power Systems 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – protection against over voltages – Bewley‟s lattice diagram.

Unit II Electrical Breakdown in Gases, Solids and Liquids 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-Applications of insulating materials in electrical equipments.

Unit III Generation of High Voltages and High Currents 9

Generation of High DC, AC, impulse voltages and currents. Tripping 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 – Power frequency, impulse voltage and DC testing – International and Indian standards – Insulation Coordination & testing of cables.

Total: 45 Periods

TEXT BOOKS:

1. Naidu M.S., Kamaraju V,” High Voltage Engineering ”, Tata McGraw Hill,4th Edition, 2009.
2. Uppal, S.L,” Electric Power ”, Khanna Publishers, 13th Edition, 2003.

REFERENCE BOOKS:

1. Kuffel ., Zaengel W.S,” High Voltage Engineering Fundamentals ”, Pergamon Press, 2 nd edition, 2000

2. Wadhwa C.L, ” High Voltage Engineering ”, New Age International Pvt. Ltd., Third Edition, 2010

3. Chakrabati A., Soni M.L, Gupta P.V, " Text book on Power System Engineering ", DhanpatRai& Co Ltd,, 2011
4. Thapar B., Gupta B.R Khera L.K, " Power System Transients and High voltage Principles ", MohindraCaptial Publishers,, Revised Edition , 2009.

COURSE OUTCOMES:

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

- Explain the different breakdown theories, lightning, switching surges and measurement techniques used for high voltage ac, dc and impulse [Understand]
- Apply knowledge of insulation materials and techniques to design high voltage systems, ensuring safety and reliability in practical applications. [Apply]
- Evaluate the form of discharges in Gaseous, Liquid and Solid dielectrics. [Evaluate]
- Analyze the test procedures of different electrical apparatus as per the standards. [Analyze]
- Evaluate the performance of high voltage equipment in real-world scenarios, considering environmental factors, regulatory standards, and economic considerations for sustainable and reliable power delivery. [Evaluate]
- Develop innovative solutions for improving the efficiency and safety of high voltage systems, incorporating emerging technologies and sustainable practices. [Create]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3					3								
CO3				2										
CO4		2				3								
CO5				3		3	3				2			
CO6			3			3	3					3		

19UEE903 DESIGN OF ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on

- Magnetic circuit parameters and thermal rating of various types of electrical machines.
- Armature and field systems for D.C. machines.
- 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 method.

Unit 1 Introduction 9

Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits –Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

Unit 2 Design of DC Machines 9

Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions.

Unit 3 Design of Transformers 9

Output Equations – Main Dimensions - KVA output for single and three phase transformers – Window space factor - Overall dimensions – Operating characteristics – Regulation – No load current– Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.

Unit 4 Design of Induction Motors 9

Output equation of Induction motor – Main dimensions –Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor -– Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current –Operating characteristics.

Unit 5 Design of Synchronous Machines 9

Output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design ofrotor –Design of damper winding – Determination of full load field mmf– Design of field winding – Design of turbo alternators – Rotor design.

Total: 45 Periods

TEXT BOOKS:

1. SawhneyA.K,"A Course in Electrical Machine Design", Dhanpat Rai & Sons, Sixth edition 2010.
2. Sen S.K.,"Principles of Electrical Machine Designs with Computer Programmers", Oxford and IBH Publishing Co. Pvt. Ltd,2006.

REFERENCE BOOKS:

1. Shanmugasundaram A., Gangadharan and Palani R, "Electrical Machine Design Data Book", New Age International Pvt .Ltd., 2007.
2. Upadhyay K.G.," Design of Electrical Machines", New Age International Pvt. Ltd., 2008
3. Agarwal R.K., "Principles of ElectricalMachineDesign",S.K.Kayaria&Sons,2007
4. Eclayton A.and NN Hancock,, "The performance and Design of Direct current Machines", CBS & Distributors Pvt. Ltd, 2004.

COURSE OUTCOMES:

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

- Apply the knowledge of electrical & thermal considerations and standards for the design of electrical machines. [Apply]
- Design a DC machine for the given specifications.[Create]
- Estimate main dimensions and cooling tube arrangement for the design of transformers.[Evaluate]
- Design an Induction machine for the given specifications.[Create]
- Design a Synchronous machine for the given specifications.[Create]

19UEE904 SPECIAL ELECTRICAL MACHINES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on

- Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- Construction, principle of operation and performance of permanent magnet synchronous motors.
- Construction, principle of operation, control and performance of switched reluctance motors.
- Construction, principle of operation, control and performance of stepping motors.
- Construction, principle of operation and performance of other special Machines.

Unit I Permanent Magnet Brushless DC Motors 9

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations-Power Converter Circuits and their controllers-Characteristics and control- Applications.

Unit II Permanent Magnet Synchronous Motors 9

Constructional features -Principle of operation – EMF and Torque equations - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

Unit III Switched Reluctance Motors 9

Constructional features – Principle of operation- Torque prediction –performance Characteristics -Power controllers –Control of SRM drive – Sensorless operation of SRM–Applications.

Unit IV Stepper Motors 9

Constructional features –Principle of operation –Types – Torque equation – Linear and Non-linearanalysis–Characteristics–Drivecircuits–Closedloopcontrol–Applications.

Unit V Other Special Machines 9

Constructional features – Principle of operation and Characteristics of Hysteresis motor- Synchronous Reluctance Motor–Linear Induction motor-Repulsion motor- Applications.

Total: 45 Periods

TEXT BOOKS:

1. T.J.E.Miller,Brushless magnetandReluctancemotordrives,Claredonpress,London,1989.
2. R.Krishnan,SwitchedReluctancemotordrives,CRCpress,2001.
3. T.Kenjo, Stepping motors and their microprocessor controls, Oxford University

press, New Delhi,2000.
4. K.Venkataratnam,SpecialElectricalMachines,UniversitiesPress,2014.
5. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014

REFERENCE BOOKS:

1. T.Kenjo and S.Nagamori, Permanent magnet and Brushless DC motors, Clarendon press, London,1988.
2. R.Krishnan, Electricmotordrives,PrenticehallofIndia, 2002.
3. D.P.Kothari and I.J.Nagrath, Electric machines, Tata McGraw hill publishing company, New Delhi,Third Edition,2004.
4. Irving L.Kosow, Electric Machinery and Transformers, Pearson Education, Second Edition, 2007.

COURSE OUTCOMES:

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

- Explain the construction, principle of operation and performance of special electrical machines [Understand]
- Identify the performance parameters of power control circuits used for special electrical machines [Apply]
- Analyze the performance characteristics of special electrical machines [Analyze]
- Recommend a suitable special electrical machine to meet out the requirement of real time application [Evaluate]
- Design a suitable conrtoller circuit for a given special electrical machine by using open source simulator/ Software [Create]
- Compare the conventional and recent methods of controlling techniques in the development of special electrical machines [Analyze]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3		3												
CO4				3										
CO5			3		3									
CO6		1										3		

19UEE905	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

To impart knowledge on

- To impart knowledge on the various power quality phenomenon, their origin and monitoring and mitigation methods.
- To discuss the effects of various power quality phenomenon in various equipment.

Unit I Introduction to Power Quality 9

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients – short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve – Information Technology Information (ITI) Curve.

Unit II Voltage Sags and Interruptions 9

Sources of sags and interruptions - estimating voltage sag performance -Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

Unit III Overvoltages 9

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltages wells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

Unit IV Harmonics 9

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion -voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

Unit V Power Quality Monitoring 9

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems- modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools -power line disturbance analyzer –quality measurement equipment - harmonic /

spectrum analyzer - flicker meters – disturbance analyzer. Applications of expert systems for power quality monitoring.

Total: 45 Periods

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso and H.WayneBeaty, “Electrical Power Systems Quality”, McGraw Hill,2012

2. Arrillaga J., N.R. Watson and S. Chen, “Power System Quality Assessment”, New York: Wiley,2000.

REFERENCE BOOKS:

1. Heydt G.T., “Electric Power Quality”, 2nd Edition, Stars in a Circle Publications, 1994.

2. Bollen M.H.J., “Understanding Power Quality Problems: Voltage Sags and Interruptions”, New York: IEEE Press, 1999.

3. Sankaran C., “Power Quality”, CRCPress, Taylor Francis Group,2002

4. PSCAD User Manual

COURSE OUTCOMES:

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

- Understand the various power quality phenomena, causes, monitoring and mitigation methods. [Understand]
- Determine the Sources of different power quality issues and choose appropriate Mitigation Technique / Device. [Apply]
- Demonstrate an understanding of power quality terms, standards and norms of Engineering Practice. [Understand]
- Analyze the sources and effects of harmonics on the power distribution system. [Analyze]
- Develop a model to improve the Power Quality in the Power Distribution System under steady / Transient state using simulation software. [Create]
- Write an effective reports as a team for the given scenario and suggest suitable modern FACTS devices to improve the Power Quality in Power Distribution System. [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3						3		3						
CO4		3												
CO5			3		3									
CO6									3	3		3		

19UEE906	FUNDAMENTALS OF FACTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To introduce the reactive power control techniques.
- To impart knowledge on static VAR compensators, Thyristor controlled series capacitors, STATCOM devices, FACTS controllers and their applications.
- To discuss the transient stability on power system and to familiarize with the FACTS controller interaction and co- ordination.

Unit I Introduction to Facts 9

Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

Unit II Static Var Compensator (SVC) and Applications 9

Need for compensation- Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator – Modeling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

Unit III Thyristor Controlled Series Capacitor (TCSC) and Applications 9

Operation of the TCSC – Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

Unit IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics - Applications: Steady state power transfer-Enhancement of transient stability - Prevention of voltage instability - SSSC-operation of SSSC and the control of power flow –Modeling of SSSC in load flow and transient stability studies.

Unit V CO-ORDINATION OF FACTS CONTROLLERS 9

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms. Unified power flow controller (UPFC) basic operating principles – introduction to sub synchronous Resonance - Independent real and reactor power flow control- control schemes for P and Q control. Inter line power flow controller (IPFC).

Total: 45 Periods

TEXT BOOKS:

1. Mohan Mathur R. and Rajiv K.Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc, 2002.

2. Narain G. Hingorani, “Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors, Delhi- 110 006.

REFERENCE BOOKS:

1. John A.T., “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 1999.

2. Sood . V.K., “HVDC and FACTS controllers – Applications of Static Converters in Power System”, April 2004 , Kluwer Academic Publishers, 2004.

3. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, “Flexible AC Transmission System: Modelling and Control” Springer, 2012.

4. Padiyar K.R.,” FACTS Controllers in Power Transmission and Distribution”, New Age International(P) Limited, Publishers, New Delhi, 2008.

COURSE OUTCOMES:

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

 Describe the operating characteristics of various FACTS controller and their roll on enhancing maximum power transfer capacity. [Understand]

 Analyze the impact of FACTS components on power system stability and damping. [Analyze]

 Analyze the modeling of power flow studies. [Analyze]

 Compute basic mathematical models for FACTS devices [Apply]

 Analyze the interactions and coordination amongst various FACTS Controllers [Analyze]

19UEE907	HVDC TRANSMISSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To familiarize the concept, planning of DC power transmission and comparison with AC power transmission
- To explain HVDC converters and HVDC system control
- To discuss about harmonics and design of filters

Unit I Introduction 9

Introduction to HVDC transmission: Early discoveries and applications, Limitation and advantages of AC and DC transmission, Classification of HVDC links- Components HVDC Transmission system, Ground Return Advantages and Problems, Advances in HVDC transmission. HVDC system application in wind power generation.

Unit II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

Unit III CONVERTER AND HVDC SYSTEM CONTROL 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 – Control of VSC based HVDC link.

Unit IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Harmonics & Filters: Characteristics Harmonics and Un-Characteristics Harmonics, Causes, Consequences, Trouble Caused by Harmonics, Means of Reducing Harmonics, Filters, Design of AC & DC Filters

Unit V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.

Total: 45 Periods

TEXT BOOKS:

1. Padiyar, K. R., “HVDC power transmission system”, New Age International (P) Ltd., New Delhi,Second Edition, 2010.

2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley inter science, New York,

London, Sydney, 1971.

3. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age International (P) Ltd., New Delhi, 1990.

REFERENCE BOOKS:

1. Kundur P., “Power System Stability and Control”, McGraw-Hill, 1993.

2. Colin Adamson and Hingorani N. G., “High Voltage Direct Current Power Transmission”, GarrawayLimited, London, 1960.

3. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.

4. Kamakshaiah S., and Kamaraju V., “HVDC Transmission”, Tata McGraw Hill Education private Limited, 2011.

COURSE OUTCOMES:

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

- Identify significance of dc over ac transmission systems, types of HVDC link, Components of HVDC system and applications. [Understand]
- Analyze the behavior of converters under different conditions [Analyze]
- Design AC and DC filters [Create]
- Model HVDC System [Apply]
- Application of Simulation Tools in HVDC Transmission [Apply]

19UEE908 EHVAC AND DC TRANSMISSION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To understand the need of EHV transmission and modern trends in EHV AC & DC transmission.
- To familiarize with the operation of EHV AC transmission system.
- To choose the optimal reactive power for the successful operation of EHV system.
- To impart the knowledge on types, control and protection of EHV system.

Unit I INTRODUCTION 9

Need of EHV transmission - standard transmission voltage - comparison of EHV AC & DC transmission systems and their applications & limitations - surface voltage gradients in conductor - distribution of voltage gradients on sub-conductors - mechanical considerations of transmission lines - modern trends in EHV AC & DC transmission.

Unit II EHV AC TRANSMISSION 9

Corona loss formulas, corona current, audible noise - generation and characteristics corona pulses their generation and properties - radio interference (RI) effects - over voltage due to switching - Ferro-resonance - reduction of switching surges on EHV system - principle of half wave transmission.

Unit III EXTRA HIGH VOLTAGE TESTING 9

Characteristics and generation of impulse voltage - generation of high AC and DC voltages - measurement of high voltage by sphere gaps and potential dividers - Consideration for design of EHV Lines - Design factors under steady state limits - EHV line insulation design based upon transient over voltages - Effects of pollution on performance of EHV lines.

Unit IV EHV DC TRANSMISSION 9

Types of dc links - converter station, choice of converter configuration and pulse number - effect of source inductance on operation of converters - principle of dc link control, converter controls characteristics - firing angle control, current and excitation angle control, power control - starting and stopping of dc link.

Unit V PROTECTION OF EHV DC TRANSMISSION 9

Converter faults, protection against over currents and over voltage - Smoothing reactors, generation of harmonics - ac and dc filters - multi - terminal dc systems (MTDC): Types, control, protection and application.

Total: 45 Periods

TEXT BOOKS:

1. M.H.Rashid, “Power Electronics: Circuit, Devices and Applications” Prentice hall of India.
2. S.Rao, “EHV AC & HVDC Transmission Engineering and practice” Khanna Publishers, Delhi, 1990.
3. Rokosh Das Begamudre,” Extra High Voltage AC Transmission Engineering”– Wiley Eastern LTD., NEW DELHI 1990.

REFERENCE BOOKS:

1. Subir Ray, “An Introduction to High Voltage Engineering”, Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, “Extra High Voltage AC Transmission Engineering”– New Academic Science Ltd; 4 edition 2011.
3. Edison, “EHV Transmission line” Electric Institution, GEC, 1968.
4. Kimbark, “HVDC Transmission” John Willy & sons publisher.
5. Arrillaga, “HVDC Transmission” 2nd Edition, IEE London publisher.
6. Padiyar, “HVDC Transmission” 1st Edition, New age international publisher.

COURSE OUTCOMES:

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

- Summarize and explain the concepts of HVAC and DC Transmission and HVDC Converters. [**Understand**]
- Apply the knowledge of Extra High Voltage in the selection of EHV line design. [**Apply**]
- Analyze the importance of Extra High Voltage components in electrical utility systems. [**Analyze**]
- Estimate the optimal level of reactive power for the successful operation of HVAC and DC Transmission system. [**Evaluate**]
- Apply the knowledge of protection against over currents and over voltage and select a suitable type of protective gears. [**Apply**]

CO – PO MAPPING

CO	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO.1														2
CO.2	3					2								
CO.3		3												
CO.4			3				2							
CO.5				3		2		2				2		

19UEE909	ENERGY AUDIT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To understand the energy scenario and concept of energy audit.
- To familiarize with energy management strategies in motors, lighting and HVAC systems.
- To choose the energy efficient motors, lightings and AC system for future use.
- To impart the knowledge on meters and instruments used in energy auditing.

Unit I ENERGY SCENARIO AND ENERGY AUDIT 9

Importance of energy in economic development and social transformation - Indian energy scenario - Need for energy management - Role of Energy Managers in Industries – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Energy conservation act - 2001 & its features - Energy Security.

Unit II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9

Energy management for electric motors – Transformer and reactors - Capacitors and Synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

Unit III ENERGY MANAGEMENT IN LIGHTING SYSTEMS 9

Task and the working space in lighting system - Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

Unit IV ENERGY MANAGEMENT IN REFRIGERATION & AIR CONDITIONING 9

Heat load estimation - Energy conservation in cooling towers & spray ponds – Case studies Energy efficiency and Energy balance – Energy conservation and opportunities in HVAC systems – Case studies.

Unit V INSTRUMENTS AND METERS IN ENERGY AUDIT 9

Metering location vs. requirements - metering techniques and practical examples - Meters and Instruments used in energy audit: MD meter, Wattmeter, Multi-tasking solid state meters - Flue gas analyzers - PQ analyzers - Infrared thermography - Energy efficiency calculation in lighting and pumping applications - plant energy audit report**.**

Total: 45 Periods

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. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.
3. Albert Thumann,Terry Niehus A Handbook of Energy Audits, Ninth Edition, 2012.
4. Craig B. Smith,"Energy Management Principles", Pergamon Press, 2015.

REFERENCE BOOKS:

1. Charles E Brown, Springer, World Energy Resources, 2012.
2. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.
3. Reay D.A, Industrial Energy Conservation, 1st edition, Pergamon Press, 1977.
4. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
5. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
6. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.
7. National Productivity Council Guide Books.

COURSE OUTCOMES:

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

- Illustrate the concepts of energy management and auditing. [Understand]
- Apply the knowledge of energy efficiency in the selection of motors, lightings and HVAC systems for industrial and domestic applications. [**Apply**]
- Analyze the importance of implementing energy efficient measures and practices in electrical utility systems for sustainable development of Energy sector. [Analyze]
- Estimate the optimal sizing of refrigeration and air-conditioning systems with the consideration of energy conservation measures, Engineering Standards and Ethical Policies. [Evaluate]
- Analyze the suitable energy audit technique, procedure and bench marking in energy audit with the knowledge of various electrical equipment and metering. [**Analyze**]
- Write effective Energy Audit reports as a team for the given scenario and suggest suitable Energy management tasks [Psychomotor Domain]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3		3				3	3							
CO4				3		3		3						
CO5		3				3								
CO6									3	3	3			

19UEE910	ELECTRICAL EQUIPMENT'S ERECTION AND COMMISSIONING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To impart knowledge on installation, commissioning and testing of transformers, Synchronous machines, Induction machines and Earthing, Relays and Circuit Breakers.

Unit I INSTALLATION OF TRANSFORMERS 9

Power and distribution transformers as per BIS standards- Location, site, selection, foundation details (like bolts size, their number, etc), code of practice for terminal plates, polarity & phase sequence, oil tanks, drying of windings and general inspection.

Unit II COMMISSIONING AND TESTING OF TRANSFORMERS 9

Commissioning - Volt ratio test, earth resistance, oil strength, Bucholz& other relays, tap changing gear, fans & pumps, insulation test, impulse test, polarizing index, load & temperature rise test. **Testing -** Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal & abnormal conditions.

Unit III INSTALLATION, COMMISSIONING AND TESTING OF SYNCHRONOUS MACHINES 9

Installation: Physical inspection, foundation details, alignments, excitation systems, cooling and control gear, drying out.

Commissioning Tests: Insulation, Resistance measurement of armature & field windings, Waveform & telephone interference tests, line charging capacitance.

Performance tests: Various tests to estimate the performance of generator operations, slip test,

maximum lagging current, maximum reluctance power tests, sudden short circuit tests, transient &sub transient parameters, temperature rise test, and retardation tests.

Unit IV INSTALLATION, COMMISSIONING AND TESTING OF INDUCTION MOTORS 9

Installation: Location of the motors (including the foundation details) & its control apparatus, shaft& alignment for various coupling, fitting of pulleys & coupling, drying of windings.

Commissioning Test: Mechanical tests for alignment, air gap symmetry, tests for bearings, vibrations& balancing.

Electrical Tests: Insulation test, earth resistance, high voltage test, starting up, failure to speed upto take the load, type of test, routine test.

Unit V EARTHING, RELAYS AND CIRCUIT BREAKERS 9

Reasons of earthing, earthing system, earth lead and its size, permissible earth resistance for different installations, improvement of earth resistance, double earthing, earth resistance measurement, rules for earthing.Testing and maintenance of Relays and Circuit Breakers - Testing of Relays Factory test, commissioning test and preventive periodic maintenance test. Testing of circuit breakers, voltage test, type test, preventive maintenance of circuit breaker.

Total: 45 Periods

TEXT BOOKS:

1. Testing & Commissioning Of Electrical Equipment -S. Rao,Khanna Publishers,2004

2. Testing & Commissioning Of Electrical Equipment -B .V. S. Rao, Media Promoters and Publication Pvt., Ltd.

REFERENCE BOOKS:

1. Relevant Bureau of Indian Standards
2. A Handbook on Operation and Maintenance of Transformers- H. N. S. Gowda, Publishedby H. N. S. Gowda,2006
3. Handbook of SwitchGears,BHEL, TMH,2005.
4. J and P Transformer Book, Elsevier Publication.
5. Rao, S., “Testing, commissioning, operation and maintenance of electrical equipment”, 6/E., Khanna Publishers, New Delhi
6. Paul Gill, “Electrical power equipment maintenance and testing”, CRC Press, 2008.
7. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi.

COURSE OUTCOMES:

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

- Apply standards and code of practice for the installation of transformers. [Apply]
- Apply routine test procedures for proper commissioning of transformers and determine its performance. [Apply]
- Apply the procedures for installation, commissioning and testing of synchronous machines. [Apply]
- Apply the procedures for installation, commissioning and testing of induction motors. [Apply]
- Apply the procedures and standards for installation, commissioning and testing of earthing, switchgear & protective devices. [Apply]

19UEE911	ELECTRICAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To enable the students understand the operation of restructured power system, issues and technical challenges related to restructuring

Unit I INTRODUCTION TO ELECTRICAL SAFETY & ELECTRICAL SHOCKS 9

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety.

Electrical shocks : Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

Unit II SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT 9

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

Unit III ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS 9

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

Unit IV ELECTRICAL SAFETY IN HAZARDOUS AREAS 9

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

Unit V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS & IE RULES 9

Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees. Review of IE rules : Objective and

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

Total: 45 Periods

TEXT BOOKS:

1. S. Rao, Prof. H.L. Saluja, “Electrical safety, fire safety Engineering and safety management”, Khanna Publishers. New Delhi, 1988.(units-I to V)

2. www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)

REFERENCE BOOKS:

1. Pradeep Chaturvedi, *“Energy management policy, planning and utilization”,* Concept Publishing company, New Delhi, 199.

COURSE OUTCOMES:

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

- Explain the restructuring of electric power supply industry. [Understand]
- Summarize the Safety aspects during Installation of Plant and Equipment. [Understand]
- Describe the electrical safety in residential, commercial and agricultural installations. [Understand]
- Describe the various Electrical Safety in Hazardous Areas, Equipment Earthing and System Neutral Earthing. [Understand]
- State the electrical systems safety management and IE rules. [Understand]

19UEE912	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- Historical development and Laws of robotics.
- Concept of various kinds of actuators, sensors and vision systems of robots.
- Robot programming and path planning.
- Recent advancement in Robotics.

Unit I INTRODUCTION 9

Automation and Robotics, Asimov'slaws of robotics, Robot Definitions, Robotic Systems and Robot Anatomy – Link – Joint – manipulator – Wrist – End effector – Actuators – Sensors – Controller, Classification of robots.

Unit II ROBOT ACTUATORS AND POWER TRANSMISSION SYSTEM 9

Robot drive mechanisms - Hydraulic and Pneumatic systems - Electric Drives – DC PMMC motor and Brushless DC Motor – Servomotor – Stepper Motor, Determination of HP of motor - variable speed arrangements, Mechanical Transmission method – Gear Transmission – Belt Drive – Cables – Roller Chains, Rotary to Rotary motion conversion - rotary to linear motion conversion mechanisms – Rack and pinion drives, Robot end effectors - Types.

Unit III ROBOT SENSORS AND VISION SYSTEM 9

Sensor Characteristics, Review of Sensors - Potentiometers – Encoders – LVDT — Tachogenerators – Strain Gauge sensors, Position Sensors, Velocity Sensors, Proximity Sensors,Touch sensors, Force and torque sensors, Robot Vision systems: Block Diagram of Robot Vision System – Image Capture Cameras – vision and Solid state – Lighting technique and devices – Image representation – Image Segmentation - Feature extraction - Object Recognition.

Unit IV ROBOT KINEMATICS 9

Rotation Matrix, Composition of Rotation matrices - Euler Angles - Homogeneous Transformations for the manipulator - The forward and inverse problem of manipulator kinematics - Jacobian in terms of D-H matrices – Controller architecture.

Unit V PATH PLANNING AND APPLICATIONS 9

Path Planning – Point-To-Point Motion – Motion Through sequence of Points, Robot programming languages, Applications: Material transfers: Machine loading and unloading - Processing operations: Automatic Spot welding & Spray coating Robots – Assembly and inspection: Bowl feeder, Parts Mating, Assembly system configuration.

Total: 45 Periods

TEXT BOOKS:

1. S. Rao, Prof. H.L. Saluja, “Electrical safety, fire safety Engineering and safety management”, Khanna Publishers. New Delhi, 1988.(units-I to V)
2. www.apeasternpower.com/downloads/elecact2003.pdf (Part of unit-V)

REFERENCE BOOKS:

1. Pradeep Chaturvedi, *“Energy management policy, planning and utilization”,* Concept Publishing company, New Delhi, 199.

COURSE OUTCOMES:

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

- Explain the various parameters and concept used in operation of robotics in various applications. **[Understand]**
- Apply suitable concepts of various kinds of actuators, sensors and power transmission system to meet product requiements. [Apply]
- Solve robot dynamics problems and generate joint trajectory for path planning [Apply]
- Identify the significance, social impact and future prospects of robotics and automation in various engineering applications [Apply]
- Analyze various control techniques in Robot kinematics for the motion of robots. [Analyze]
- Develop a sustainable design of robot mechanism to meet kinematics requirements with appropriate programming. [Create]

CO –PO MAPPING

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1														
CO2	3													
CO3	3													
CO4	3					3						3		
CO5		3												
CO6			3		3		3							

19UEE913	SOLAR AND WIND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To study the current scenario of the implementation of Renewable energy conversion systems.
- To understand the solar radiation and its measurement techniques.
- To attain a broad comprehension on solar photovoltaic system and solar thermal energy conversion system.
- To learn the design and control principles of Wind turbine.

Unit I GLOBAL AND NATIONAL ENERGY SCENARIO 9

World energy resources-Indian energy scenario- Importance of Renewable energy -Global solar resources, Solar insolation- -Radiation absorption, scattering - Measurement of Solar Radiation on horizontal and tilted surfaces Solar energy system, Measurement of radiation-Pyranometer-Pyrheliometer-Sunshine recorder.

Unit II SOLAR THERMAL ENERGY CONVERSION 9

Solar thermal energy- Solar flate plate collector, Solar evacuated tube collector-Pool and Air collectors Construction -Function - Solar heating and cooling system - Real time issues in solar thermal systems-Comparison of solar thermal and Solar PV systems.

Unit III SOLAR PHOTOVOLTAIC SYSTEMS 9

Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Solar Cell Technologies, Solar Cell, Module, and Array Construction, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker. Balance of System Components, Solar PV Systems, Solar PV Applications.

Unit IV WIND ENERGY CONVERSION SYSTEMS 9

Wind source-wind statistics-Wind Energy Conversion System (WECS) siting-Classification-Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Aerodynamics of Wind turbine.

Unit V WIND TURBINES 9

HAWT - VAWT - Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-Number of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction-wind Applications.

Total: 45 Periods

REFERENCE BOOKS:

1. G.D.Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.
2. CS Solanki, Solar Photovotaics,Fundamentals, Technologies and Applications, 2nd edition, PHI Learning Pvt. Ltd., 2011.
3. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications PrenticeHall, 2008.
4. H.P. Garg and J. Prakash., Solar Energy,Fundamentals& Applications, Tata McGraw Hill book Co, New Delhi, 1997.
5. S.P. Sukhatme, J.K. Nayak, Solar Energy-Principle of thermal storage and collection, Tata McGraw Hill book Co, New Delhi, 2008.
6. G.N.Tiwari, Solar Energy-Fundamentals, Design,Modeling and Applications,Narosha Publishing House Ltd.,2002.
7. L.L.Freris,Wind Energy conversion Systems, Prentice Hall, 1990.
8. S.N.Bhadra, D.Kastha,S.Banerjee,Wind Electrical Sytems,Oxford University Press,2010.

COURSE OUTCOMES:

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

- Explain the world, Indias energy resources along with solar radiation spectrum and measuring instruments for solar energy. [Understand]
- Classify the different types of solar thermal energy collectors. [Understand]
- Analyse the I-V characteristics of Solar PV System and MPPT algorithm. [Analyze]
- Analyze the performance of WECS and select a suitable site. [Analyze]
- Analyze the control mechanism for wind turbine. [Analyze]

19UEE914 POWER SYSTEM RESTRUCTURING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To enable the students understand the operation of restructured power system, issues and technical challenges related to restructuring

Unit I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction about deregulation – Structure of restructured electric utility – Different entities – Deregulation situation around the world – Benefits from competitive electricity market – After effects of deregulation. Role of Load Managers.

Unit II FUNDAMENTALS OF ECONOMICS 9

Introduction, Consumer behavior, Supplier behavior, Market equilibrium, Short-run and Long-run costs, Various costs of production, Relationship between short-run and long-run average costs, Perfectly competitive market.

Unit III TRANSMISSION OPEN ACCESS AND PRICING ISSUES 9

Power wheeling – Types of transmission services in open access – Cost components in transmission – Pricing of power transactions – Pricing mechanisms in various countries – Congestion management in deregulation.

Unit IV ANCILLARY SERVICES MANAGEMENT 9

General description of some ancillary services – Ancillary service management in various countries – Reactive power as an ancillary service – Synchronous generators as ancillary service providers.

Unit V TECHNICAL CHALLENGES AND AVAILABILITY BASED TARIFF 9

Total Transfer Capability – Limitations - Margins – Available transfer capability (ATC) – Procedure - Methods to compute ATC – Static and Dynamic ATC –Concept of Congestion Management – Bid, Zonal and Node Congestion Principles - Generation Rescheduling. Availability based tariff – Necessity – Working Mechanism – Beneficiaries – Day Scheduling Process – Deviation from Schedule – Unscheduled Interchange Rate – System Marginal Rate – Trading Surplus Generation – Applications.

Total: 45 Periods

TEXT BOOKS:

1. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, “Operation of Restructured Power Systems”, Kluwer Academic Publishers, 2001

2. Fundamentals of Power System economics Daniel Kirschen and Goran Strbac, John Wiley & Sons Ltd, 2004.

REFERENCE BOOKS:

1. Shahidehpour.M and Alomoush.M, “Restructuring Electrical Power Systems”, Marcel Decker Inc., 2001.

2. G.Zaccour, “Deregulation of Electric Utilities”, Kluwer Academic Publishers 1998.

3. M.Illic, F.Galiana and L.Fink, “Power Systems Restructuring: Engineering and Economics”, Kluwer Academic Publishers, 2000.

COURSE OUTCOMES:

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

- Explain the objectives and precautions of Electrical Safety, effects of Shocks and their Prevention. [Understand]
- Understand the basic fundamentals of economics. [Understand]
- Explain the fundamental concepts of congestion management. [Understand]
- Describe the ancillary services management [Understand]
- Describe the technical challenges and availability based tariff. [Understand]

19UEE915	APPLICATION OF POWER ELECTRONICS TO POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To Impart knowledge on different types of converter configurations.
- To Study the different characterizes applications of converters in HVDC systems.
- To Design and analyse the different types of reactive power compensation schemes for converters

Unit I HVDC SYSTEM 9

HVDC configurations, components of HVDC system: Converter, transformer, smoothing reactor, harmonic filter. Reactive power support, operation of 6-pulse controlled rectifier in inverting mode of operation. Operation of 12- pulse converter. Control of HVDC system, Rectifier and inverter characteristics, mode stabilization, current control, voltage dependent current order limit, combined rectifier-inverter characteristics, valve blocking and by - passing, limitations HVDC system using line commutated converters, modern HVDC system - HVDC light.

Unit II ANALYSIS OF CONVERTERS AND THEIR CONTROL 9

Pulse number-analysis of Graetz circuit-characteristics of twelve pulse converter - Dc link control - converter Principal of DC Link Control - Converters Control Characteristics - Firing angle control - Current and extinction angle control - Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

Unit III LOAD BALANCING 9

Limitations of load balancing using passive elements, Use of VSI as a Var generator, Indirect current controlled synchronous link converter Var Compensator (SLCVC). Bi-directional power flow in VSI, Use of VSI as active filter cum Var generator, Current controlled SLCVC, Strategy-1: Sensing the compensator current, Strategy-2: Sensing the source current, Use of two VSIs, one as Var generator and another as active filter.

Unit IV REACTIVE POWER COMPENSATION 9

Instantaneous reactive power theory, expression for active and reactive powers in terms of d-q components. Reactive power compensator using instantaneous reactive power theory, stationary to rotating frame transformation. Reference wave generation (hardware method), harmonic oscillator, Phase locked loop (PLL) Introduction on one cycle control, discussion on one cycle controlled Var generator and active filter.

Unit V SHUNT AND SERIES COMPENSATION 9

Introduction, methods of Var generation, analysis of uncompensated AC line, Passive reactive

power compensation, Compensation by a series capacitor connected at the mid point of the line, Effect on Power Transfer capacity, Compensation by STATCOM and SSSC, Fixed capacitor-Thyristor controlled reactor (FC-TCR), Thyristor-switched capacitor- Thyristor controlled reactor (TSC-TCR), static var compensators.

Total: 45 Periods

TEXT BOOKS:

1. K.R. Padiyar, “HVDC Power Transmission System - Technology and System Interaction", New Delhi, New Age International, 2002.
2. Jos Arrillaga, Y. H. Liu, Neville R. Watson, “Flexible Power Transmission: The HVDC Option's", John Wiley &Sons, 2007.

REFERENCE BOOKS:

1. Ewald Fuchs, Mohammad A. S. Masoum, "Power Quality in Power Systems and Electrical Machines", Academic Press, 2011.
2. Ned Mohan, Power Electronics Converters Applications and Design, New York, John Wiley and Sons, 2002.
3. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-Based FACTS Controllers for Electrical Transmission Systems", John Wiley & Sons, 2002
4. Mohd. Hasan Ali, Bin Wu, Roger A. Dougal," An Overview of SMES Applications in Power and, Energy Systems", IEEE Transactions on Sustainable Energy, vol. 1, no. 1, April 2010.

COURSE OUTCOMES:

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

- Illustrate the characteristics of different types of HVDC converter Configurations
- Determine the different control functions required for HVDC link
- Interpret load balancing in AC and DC system
- Analyze the reactive power compensation methods
- Analyze Compensation engineering problems and identify suitable shunt or Series Compensation devices for given applications

19UEE916	MODERN OPTIMIZATION TECHNIQUES FOR ELECTRIC POWER SYSTEMS	L 3	T 0	P 0	C 3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- Get familiarized with different architectures and training algorithms of neural networks.
- Get exposed to the various neural modeling and control techniques with case study using simulation tool box.
- Gain Knowledge on fuzzy set theory and fuzzy rules.
- Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box.

Unit I ARTIFICIAL NEURAL NETWORK 9

Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

Unit II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox

Unit III FUZZY SET THEORY 9

Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions

Unit IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox.

Unit V HYBRID CONTROL SCHEMES 9

Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Case study –

Familiarization with ANFIS toolbox.

Total: 45 Periods

TEXT BOOKS:

1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992.

2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000.

REFERENCE BOOKS:

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989

2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992

3. Ethem Alpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.

4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2000.

COURSE OUTCOMES:

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

- Understand the overview of artificial neural network and training algorithms.
- Analyze problems to formulate models and develop control schemes using Neuro controller systems.
- Design fuzzy controller for non-linear systems.
- Apply engineering fundamentals to use hybrid schemes and optimization algorithms to obtain solution for complex engineering problems.
- Simulate case studies using modern IT tool boxes.

19UEE917 NON-LINEAR CONTROL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- Nature of nonlinearities found in control systems both in the forward path and in the feedback path.
- Standard methods of analysis and design in nonlinear system.
- Methods suitable for nonlinear systems are introduced and their applications are explored.

Unit I PHASE PLANE ANALYSIS 9

Singular points -Construction of phase portraits, methods of isoclines-Phase plane analysis of linear systems-Phase plane analysis of nonlinear systems-Existence of limit cycles.

Unit II DESCRIBING FUNCTION 9

Stability analysis and limit cycles- Linear compensation methods- General describing functions of common nonlinearities- Relative stability.

Unit III LIAPUNOV'S DIRECT METHOD 9

Stability and instability theorems-Variable gradient method - Stability analysis- Method to select Liapunov function.

Unit IV POPOV'S METHOD 9

Popov's criterion and Circle theorem- Stability analysis of unforced and forced systems- Stability of time-varying systems-relative stability and total stability.

Unit V NONLINEAR CONTROL SYSTEM DESIGN 9

Feedback linearization- Adaptive control- Practical examples - MATLAB approach in design.

Total: 45 Periods

TEXT BOOKS:

1.Ogata, K., Modern Control Engineering, Prentice-Hall, [2002]

2.Hsu, J. C. & A. U. Meyer, Modern Control Principles and Applications, McGraw-Hill, [1968]

REFERENCE BOOKS:

1.Gopal, M., Modern Control System Theory, John Wiley Eastern Ltd. New Delhi, [1984]

2.Friedland, B., Control System Design, McGraw-Hill, [1986]

3.Ogata, K., State Space Analysis of Control Systems, Prentice-Hall, [1967]

4.DeRusso, Roy, and Close, State Variables for Engineers, John Wiley, [1988]

5.Kuo, B. C., Automatic Control Systems, Prentice-Hall, [1987]

6.Slotine, J. E. &Weiping Li, Applied Nonlinear Control, Prentice-Hall, [1991]

7.Gibson, J. E., Nonlinear Automatic Control, McGraw-Hill, [1963]
8.Khalil, Hasan K., Nonlinear Systems, Macmillan Publishing, [1992]
9.Thaler, G. J., Automatic Control Systems, West Publishing Company, [1989]

COURSE OUTCOMES:

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

- Understand the overview of artificial neural network and training algorithms.
- Analyze problems to formulate models and develop control schemes using Neuro controller systems.
- Design fuzzy controller for non-linear systems.
- Apply engineering fundamentals to use hybrid schemes and optimization algorithms to obtain solution for complex engineering problems.
- Simulate case studies using modern IT tool boxes.

19UEE918 DIGITAL CONTROL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To present the basic concepts on analysis and design of sampled data control system and to apply these concepts to typical physical processes.

Unit I Introduction to discrete time control system 9

Principle features of discrete time control system - Signal sampling, quantizing and coding - Data acquisition, conversion and distribution system - Reconstruction of original signal from sampled signal.

Unit II The Z-Transform 9

Fundamentals of Z-transform - Important properties and theorems of the Z-transform - Z-transform from the convolution integral - Inverse Z-transform: Direct Division, Partial Fraction, Inversion Integral - Z-transform method for solving difference equation

Unit III Analysis of discrete time control system 9

S-plane to Z-plane mapping and Vice-versa - Stability analysis of closed loop systems in the Z-plane - Discrete time equivalents of continuous time systems - Discrete time equivalents of analog controllers - Transient and steady state response analysis

Unit IV Design and compensation of discrete time control system 9

Digital filters: structure, implementation, frequency response, applications - Control system controllers: structure, hardware/software features, responses to control signals, use of root locus and frequency domain concepts - Phase lead and phase lag compensator design for discrete time system - PID controller design and selection of parameters for discrete time system.

Unit V Discrete time state equations 9

State space representation of discrete time systems - Discretization of the continuous time state space equation - Pulse transfer function matrix - Stability assessment from the discretized state space equations.

Total: 45 Periods

REFERENCE BOOKS:

1. K. Ogata, “Discrete Time Control Systems”, Prentice Hall, Englewood Cliffs, New Jersey.
2. Charles L. Phillips, “Digital Control System: Analysis and Design”, Prentice Hall, Englewood Cliffs, New Jersey.

COURSE OUTCOMES:

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

- Represent discrete time control systems and reconstruction of original signal from sampled
- Apply properties and theorems of the Z-transform for solving difference equations
- Analyze stability, transient response and steady state behavior of discrete-time systems and S-plane to Z-plane mapping
- Design digital control systems using root locus and frequency domain concepts
- Apply discretized state space equations in state space representation of discrete time systems

19UEE919 DESIGN WITH PIC MICROCONTROLLERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To learn the architecture of a PIC Microcontroller and also get acquainted about their use for control purpose.
- To provide the knowledge of applications and interfacing of PIC microcontrollers used in the field of Electrical and Electronics Engineering.
- To develop required skills in the students so that they are able to acquire following competencies:
- Program PIC microcontroller for data acquisition and processing application
- Interface sensors, transducers, motors, relays, and various input/output devices with PIC microcontroller.

Unit I PIC Microcontrollers: History, Features and Architecture 9

Evolution of Microcontrollers, Overview of the PIC18 Family, PIC18 PIN connection, PIC18 Registers, PIC18 data format and directives, Program counter, RISC Architecture in the PIC18.

Unit II Classification of Instructions and I/O Port Programming 9

Arithmetic Instructions, Signed Number Concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate Instruction and Data Serialization, BCD and ASCII Conversion, Branch Instructions and Looping, Call Instructions and Stack, PIC18 Time Delay and Instruction Pipeline, I/O Port Programming in PIC18, I/O Bit Manipulation Programming.

Unit III PIC18 Programming in C 9

Data Types and Time Delays in C, I/O Programming in C, Logic Operations in C, Data Serialization in C, Program ROM Allocation in C, Data RAM Allocation in C

Unit IV PIC18 Programming in C: Timer, Serial Port and Interrupt 9

Programming Timers 0, 1, 2 and 3 in C, Counter Programming, Basics of Serial Communication, PIC18 connection to RS232, PIC18 Serial Port Programming in C, PIC18 Interrupts, Programming Timer, External Hardware, Serial communication and Port B change interrupts.

Unit V PIC18 Interfacing 9

LCD Interfacing, Keyboard Interfacing, ADC Programming in the PIC18, DAC Interfacing, Sensor Interfacing and Signal Conditioning, Relays and Opto-isolators, Stepper Motor Interfacing, DC Motor interfacing and PWM.

Total: 45 Periods

TEXT BOOKS:

1. Muhammad Ali Mazidi, Rolan D. McKinlay, Danny Causey, “PIC Microcontroller and Embedded system using assembly and C for PIC18”, 2008, Pearson Education International.
2. Peatman John B, “Design with PIC Microcontrollers”, 2009, 8thimpression, Pearson education International.

REFERENCE BOOKS:

1. Verle Milan,”PIC Microcontrollers – Programming in C”, Mikroelektronika, 1 st Edition, 2009.
2. MaticNebojsa, “PIC Microcontroller”, Mikroelektronika, 1st edition 2008.
3. Barnett R. H., Cox S., O'cull L, “Embedded C Programming And The Microchip PIC”, Cengage,2 nd edition 2003.

COURSE OUTCOMES:

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

- Identify and understand function of different blocks of PIC microcontroller.[Understand]
- Develop programs for data transfer, arithmetic, logical and I/O port operations. [Apply]
- Develop programs for PIC18 using “C”. [Apply]
- Develop program for PIC18 Timers, Serial port and Interrupts using “C”. [Evaluate]
- Interface LCD, Keyboard, ADC, DAC, Sensors, Relays, DC motor and Stepper motor with PIC18 microcontroller.[Analyze]

CO – PO MAPPING

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

19UEE920	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to make the students,

- To introduce the concepts of Machine Learning
- To understand the concepts such as supervised, unsupervised learning algorithms and reinforcement learning.
- To develop algorithms for finding patterns or predictions from empirical data.

Unit I Introduction 9

Learning Problems Designing a Learning System, Perspectives and Issues in Machine Learning . Concept Learning, task ,search, finding maximally specific Hypotheses ,version spaces and candidate elimination algorithm inductive bias.

Unit II Prediction 9

Linear Regression Non Linear Regression Decision Tree Learning: Decision Tree Representation Problems, basic decision tree, learning algorithms, hypotheses search, Issues .Artificial Neural Networks: Introduction, Representations, Problems, Perceptrons, Multilayer networks and Back Propagation Algorithm example.

Unit III Supervised Learning 9

Bayesian Learning: Bayes Theorem ,Concept Learning , Maximum Likelihood and Least-Squared Error Hypothesis .Bayes Optimal, Classifier, Gibbs Algorithm, Naïve Bayes Classifier ,Example. Instance Based Learning: Introduction – k-Nearest Neighbour Learning, Locally Weighted Regression , Radial Basis Functions , Case- Based Reasoning.

Unit IV Unsupervised Learning 9

K – Means – K Medoids – Genetic Algorithms: Introduction, Example :Hypothesis Space Search Genetic Programming, Models of Evolution and Learning – Parallelizing Genetic Algorithms.

Unit V Learning Sets of Rules 9

Learning sets of rules: Introduction , sequential covering algorithms, First order rules, FOIL Induction as Inverted deduction , inverting resolution ,Reinforcement Learning: Introduction Markov Decision Processes ,Values,SARSA vs Q-Learning.

Total: 45 Periods

TEXT BOOKS:

Tom M. Mitchell, "Machine Learning", 1st Edition, McGraw-Hill Education, India, 2013.

REFERENCE BOOKS:

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Jiawei Han & MichelineKamber, "Data Mining Concepts and Techniques", 3rd Edition, Elsevier, 2012.

COURSE OUTCOMES:

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

- Outline the fundamental concept of machine learning. [Understand]
- Implement regression, decision tree and Artificial neural networks for real world problems [Apply]
- Detect parametric and non –parametric algorithms for solving real world problem (Analyze)
- Identify the perspectives of machine learning and formulating hypothesis. [Analyze]
- Assess real world problems associated with probability and error based learning. [Evaluate]
- Formulate solutions to classification problems using multilayer perceptron. [Create]

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	3	2	1									
CO3	3	3	2									
CO4	3	3	2									
CO5	3	2	1	2								
CO6	3	2	1	3								

19UEE921 FUZZY SYSTEMS AND GENETIC ALGORITHM

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

The purpose of this course is to teach the students about the basic techniques, theory and computational models of Fuzzy systems. This subject focuses on how to apply several Genetic algorithms over real-time problems to get optimized outcome.

Unit I **7**

Introduction: Introduction to Neural Network, Fuzzy Logic, Genetic Algorithm. Fuzzy sets-fuzzy set operations, Properties of fuzzy sets. A brief history of evolutionary computation, biological terminology, search space encoding, reproduction elements of genetic algorithm genetic modeling, comparison of GA and traditional search methods.

Unit II **8**

Fuzzy Set Theory: Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning using IF-THEN rules, Extension Principle and Fuzzy Relations, Fuzzy Inference Systems, Different Fuzzy Models: Mamdani Fuzzy Models, Sugeno Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

Unit III **8**

Fuzzy Logic &Fuzzy Rule-Based Systems: Fuzzy logic, approximate reasoning, Fuzzy tautologies, Contradictions, Equivalence and logical proofs. Natural language, Linguistic hedges, Rule-based system canonical rule forms, Decomposition of compound rules, Likelihood and truth qualification, Aggregation of fuzzy rules.

Unit IV **8**

Elementary and Advance Search Techniques: State Space Search, Blind Search, Heuristic Search(Hill Climbing, A/A* Algorithm, Min-Max Search, Constraint Satisfaction), Multi-Objective Genetic Algorithm.

Unit V **8**

Concepts of Genetic Algorithms, GA techniques, Simulated Annealing, Random Search, Downhill Simplex Search, Evolutionary Computing, Swarm optimization, Green Computing, Big data mining.

Unit VI **6**

Applications of Genetic based machine learning-Genetic Algorithm and parallel processors-composite laminates- constraint optimization- multilevel optimization- real life problem.

Total: 45 Periods

REFERENCE BOOKS:

1. Fuzzy Logic with Engineering Applications,Timothy J. Ross,McGraw-Hill,1997.

2. Genetic Algorithms: Search, Optimization and Machine Learning, Davis E. Goldberg, Addison Wesley, N.Y.,1989.

3. Neural Networks, Fuzzy Logic and Genetic Algorithms, S. Rajasekaran and G.A.V.Pai, PHI, 2003.

4.David A. Coley, "An Introduction to Genetic Algorithms for Scientists and Engineers ".

5. Melanie Mitchell- 'An introduction to Genetic Algorithm'- Prentice-Hall of India.

COURSE OUTCOMES:

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

- Recognize and depict soft computing methods and their roles to build intelligent systems.(Knowledge)
- Apply fuzzy principles and thinking to deal with vulnerability and tackle realtime issues.(Apply)
- Apply genetic algorithms to generate optimized results for a particular problem. (Apply)
- Evaluate and compare solutions by various soft computing approaches for a given problem.(Evaluate)

19UEE922 SENSING TECHNIQUES AND SENSOR SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To provide in depth knowledge in physical principles applied in sensing, measurement and a comprehensive understanding on how measurement systems are designed, calibrated, characterized, and analyzed.
2. To introduce the students to sources and detectors of various Optical sensing mechanisms and provide in-depth understanding of the principle of measurement, and theory of instruments and sensors for measuring velocity and acceleration.
3. To give a fundamental knowledge on the basic laws and phenomena on which operation of sensor transformation of energy is based.
4. To impart a reasonable level of competence in the design, construction, and execution of mechanical measurements strain, force, torque and pressure.

Unit I Sensor fundamentals, Optical Sources and Detectors 9

Sensor classification, performance and types, Error analysis characteristics, Electronic and optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, Photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

Unit II Strain, Force, Torque and Pressure sensors 9

Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors, Design of signal conditioning circuits for strain gauges, capacitance and optoelectronics sensors.

Unit III Position, Direction, Displacement and Level sensors 9

Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall Effect, magneto resistive, Fiber optic liquid level sensing, ultrasonic sensor, capacitive liquid level sensor, Signal condition circuits for reactive and self-generating sensors.

Unit IV Velocity and Acceleration sensors 9

Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.

Unit V Flow, Temperature and Acoustic sensors 9

Flow sensors: pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer,microflow sensor, coriolis mass flow and drag flow sensor, Temperature sensors- thermoresistive, thermoelectric, semiconductor and optical, Acoustic sensors-microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

Total: 45 Periods

TEXT BOOKS:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2015, 3rd edition, Springer, New York.

2. Jon. S. Wilson, “Sensor Technology Hand Book”, 2011, 1st edition, Elsevier, Netherland.

REFERENCE BOOKS:

1. GerdKeiser,”Optical Fiber Communications”, 2017, 5th edition, McGraw-Hill Science, Delhi.

2. John G Webster, “Measurement, Instrumentation and sensor Handbook”, 2017, 2 nd edition, CRC Press, Florida.

3. Eric Udd and W.B. Spillman, “Fiber optic sensors: An introduction for engineers and scientists”, 2013, 2nd edition, Wiley, New Jersey.

4. Bahaa E. A. Saleh and Malvin Carl Teich, “Fundamentals of photonics”, 2012, 1 st edition, John Wiley, New York.

COURSE OUTCOMES:

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

- Choose an appropriate sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.[Analyze]
- Design and develop sensors using optical methods with desired properties. [Apply]
- Evaluate performance characteristics of different types of sensors. [Evaluate]
- Create analytical design and development solutions for sensors. [Create]
- Compete in the design, construction, and execution of systems for measuring physical
- quantities.[Analyze]

19UEE923	INTRODUCTION TO MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the different MEMS materials and their properties
- To study the different fabrication process used in MEMS technology.
- To introduce the fundamental working principles of different micro sensors and actuators.
- To provide insight on application areas of MEMS technology

Unit I Introduction **9**

Intrinsic Characteristics of Micro systems – Macro and micro Sensors and Actuators –Scaling laws - Silicon and polymer based MEMS processes and MEMS Materials.

Unit II Micromachining **9**

Bulk Micromachining - Surface micromachining, LIGA processes and Polymer MEMS fabrication process.

Unit III Sensors and Actuators - I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Micro motors – Inter digitated Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion– Thermal couples – Thermal resistors – Applications – Microfluidics for sensing and actuation applications.

Unit IV Sensors and Actuators - II **9**

Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

Unit V Applications **9**

Application to Acceleration, Pressure, Flow, Chemical, Inertial sensors - Optical MEMS – Bio MEMS – RF MEMS – Energy Harvesting – NEMS devices.

Total: 45 Periods

TEXT BOOKS:

1. Chang Liu, “Foundations of MEMS”, Pearson Education Inc

2. Tai Ran Hsu, “MEMS and Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2006.

3. Stephen D Senturia, “Micro system Design”, Springer International Edition, 2006.

REFERENCE BOOKS:

1. Stephen D Senturia, “Micro system Design”, Springer International Edition, 2006.

2. Gregory T. Kovacs “Micro machined Transducers Source Book”, McGraw-Hill High Education, 1998.

3. M.H.Bao, “Micromechanical Transducers: Pressure sensors, Accelerometers and Gyroscopes”, Elsevier, Newyork, 2000.

COURSE OUTCOMES:

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

- Understanding the material properties and the significance of MEMS.
- Understanding the concept of micromachining and micro fabrication.
- Apply the concepts of MEMS to design the sensors and actuators.
- Apply the fabrication mechanism for MEMS sensor and actuators.
- Select and identify the right MEMS device against the applications.

19UEE924	COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of electromechanical energy conversion.
- To design an electrical machine.
- To impact knowledge on problem formulation for field computation.
- To analyse the performance parameters for rotating machines.
- To analyse the performance parameters for linear machines.

Unit I Introduction 9

Review on electromagnetic theory – Basic field equations, calculation of field distribution, inductance, capacitance, force and torque, energy, Laplace/ poisson equations, electromechanical energy conversion for linear and rotating actuators, Difference in torque equations for cylindrical and salient pole machines.

Unit II Review on Conventional Electrical Machine Design 9

Introduction to Electrical design methods, Design Specifications, Output Equations of AC & DC Machines; Importance of specific loadings; Electrical and Magnetic Materials, Types, Linear and Non-linear Material, Standards of Electrical machines design, Heat dissipation and Cooling methods, Ventilation schemes in static (Transformers) and rotating machines; Types Of enclosures; Step by Step General design procedure for each optimal design, Limitations of conventional methods, Need for computer aided design, Advantages.

Unit III Finite Element Analysis 9

Introduction to FEM, Boundary value Problems, Boundary Conditions, formulation for 2-D planar and axial symmetry problems – governing equations, discretization, element shape functions, global matrices/vectors, solution, post processing.

Unit IV FEA Analysis of Rotating Actuators (Machines)(Practical) 9

Modelling and Analysis of DC machines, Induction Machines, Synchronous Machines and Reluctance machines. Types of Analysis-Static, Time harmonic and transient with motion conditions, Prediction of performance parameters.

Unit V FEA Analysis of Linear Actuators 9

Modelling and Analysis of Solenoid Actuators, Linear Induction Motor, Linear PMSM, Linear SRM and Transformers. Types of Analysis- Static, Time harmonic and transient with motion conditions, Prediction of performance parameters.

Total: 45 Periods

TEXT BOOKS:

1. Sheppard.J.Salon “Finite Element Analysis of Electrical Machines”, Springer International Edition, First Indian Reprint, 2007.
2. Nicola Bianchi “Electrical Machine Analysis using Finite Elements”, Taylor& Francis,2005.

REFERENCE BOOKS:

1. K.J.Binns, P.J. Lawrenson, C.W. Trowbridge, “The analytical and numerical solution of electrical and magnetic fields”,JohnWiley&Sons,1993.
2. NathanIda, JoaoPABastos,“Electromagnetics and calculation of fields”,Springer Verlag, SecondEdition,1997.
3. PP.Silvester, Ferrari, “Finite Elements for Electrical Engineers”, CambridgeUniversityPress,Third Edition,1996.
4. MVKChari, PPSilvester, “Finite Elements in Electrical and Magnetic Field problems”, JohnWiley,1980.
5. S.S.Rao,“TheFinite Element Method in Engineering”,Elsevier,2011.
6. J.N.Reddy, “An Introduction to the Finite Element Method”, Mc Graw Hill International Editions,Third illustrated edition, 2006.

COURSE OUTCOMES:

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

- Understand the basics of electromechanical energy conversion.
- Design an conventional electrical machine using finite element package.
- Define boundary conditions and formulate the equations for FEA.
- Enhance the performance parameters using FEA of rotating machines.
- Enhance the performance parameters using FEA of linear machines.

19UEE925 INTELLIGENT MOTOR CONTROLLERS

L	T	P	C
3	0	0	3

Unit I Artificial Neural Networks 9

Biological Neuron and Their Artificial Model; Models of Artificial Neural Network: Single Layer and Multilayer, Feed-forward Network, Feedback Network; Neural Processing; Types of Neuron Activation Function; Learning Strategy: Supervised, Unsupervised, Reinforcement; Learning Rules; Auto-Associative and Hetro-Associative Memory.

Unit II Back Propagation Networks 9

Architecture: Perceptron model, Single-Layer Perceptron Network, Multilayer Perception Model; Back Propagation Learning Methods; Generalized Delta Learning Rule; Back Propagation Algorithm; Factors Affecting Back-Propagation Training; Learning Factors: Initial Weights, Steepness of the Activation Function, Learning Constant, Momentum Factor, Necessary Number of Hidden Neurons.

Unit III Introduction to Fuzzy Logic 9

Classical Sets and Fuzzy Sets: Operations and Properties; Classical relations and fuzzy relations: Cartesian product, Crisp relations, Fuzzy relations, Operations on fuzzy relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition; Tolerance and Equivalence Relations; Fuzzy Tolerance and Equivalence Relations; Value Assignments.

Unit IV Fuzzy Logic System 9

Membership Function: Various Forms, Membership Value Assignments; Fuzzification and Defuzzification Module, Rule Base, Choice of Variable and Contents of Rules, Derivation of Rules, Data Base, Fuzzy Inference System, Choice of Membership Function and Scaling Factors, Choice of Fuzzification and Defuzzification Procedure, Various Methods; Fuzzy Associative Memories.

Unit V Applications of Neural Networks and Fuzzy Logic 9

Speed Control of DC Motor, Induction Motor, Switched Reluctance, Brushless DC Motor, Synchronous Machine, Modelling and Control of DC and AC Drive, Hybrid Neuro-Fuzzy Applications.

Total: 45 Periods

REFERENCE BOOKS:

1. B. Yegnanarayana, “Artificial neural networks”, Prentice Hall of India, Private limited, New Delhi.

2. J. M. Zurada, “Introduction to Artificial Systems”, Singapore: Info Access and distributions/ West Publishing Company.

3. James A. Anderson, “An Introduction to Neural Networks”, Practice Hall India Publication.
4. D. Drainkov, H. Hellendoorn and M. Reinfrank, “An Introduction to Fuzzy Control”, Narosa Publishing House.
5. SimanHaykin, “Neural Networks”, Prentice Hall of India.
6. T. J. Ross, “Fuzzy Logic with Engineering Applications”, John Wiley & Sons.
7. S. Rajsekaran& G.A. VijayalakshmiPai, “Neural network, Fuzzy logic and Genetic Algorithm”, Prentice Hall of India.
8. S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Introduction to Neural Network Using MATLAB 6.0”, Tata McGraw Hill.

COURSE OUTCOMES:

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

- Identify the basic neural networks paradigms.
- Describe the basic concepts of training in neural networks.
- Describe the concept of fuzziness involved in various systems.
- Understand the basic concepts of about fuzzy set theory.
- Analyze the different techniques used for modelling and control of the AC and DC drives.
- Apply neural network and fuzzy techniques for designing successful applications.

19UEE926	ENERGY EFFICIENT MOTORS	L	T	P	C
		3	0	0	3

Unit I Energy-Efficient Motors 9

Standard Motor Efficiency, Need of Efficient Motors, Definition Efficiency, Energy-Efficient Motor, Efficiency Determination, Motor Efficiency Labeling, NEMA Energy-Efficient Motor Standards, Fundamentals of Electric Motor Drives, Power factor.

Unit II Adjustable-Speed Drives and Their Applications 9

The Importance of Electric Motor Drives, Motor Drive Parameters, The Impact of Motor Efficiency, Current Motor Technology, Advantages of Variable-Speed Motors, Government Regulation, Adjustable-Speed Drive Applications.

Unit III Induction Motors and Adjustable-Speed Drive Systems 9

Energy Conservation, Adjustable-Speed Systems, Applications to Fans/Pumps, Applications to Constant Torque Loads.

Unit IV Brushless DC Motor Drives 9

BLDC Machine Configurations, Modeling, BLDC Power Electronic Drivers, Sensorless Techniques for BLDC Motor Drives.

Unit V Switched Reluctance Motor Drives 9

Fundamentals of Operation, Machine Configurations, Dynamic Modeling of SRMs, Control of SRMs, Other Power Electronic Drivers, Advantages and Disadvantages, Generative Mode of Operation, Energy Conversion Cycle.

Total: 45 Periods

REFERENCE BOOKS:

1. Howard E. Jordan, “Energy-Efficient Electric Motors and Their Applications”, Springer Science+ Business Media, LLC.

2. Ali Emadi, “Energy-Efficient Electric Motors”, Third Edition, Revised and Expanded, Copyright © 2005 by Marcel Dekker, NEW YORK.

COURSE OUTCOMES:

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

- Able to selecting and utilizing electric motors on the basis of energy efficiency and life-cycle cost.
- Able to understand technology of energy-efficient motors.
- Able to understand the fundamentals of power electronics applicable to electric motor drives.

- Able to understand the Adjustable speed drives and their applications (Advanced permanent magnet (PM) and brushless DC (BLDC) motor drives as well as switched reluctance motor (SRM) drives.

19UEE927	ADVANCED MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To introduce the concept of microcontroller based system development.
- To introduce the concept of RISC and CISC microcontrollers.
- To study the architecture of PIC, R8C and MSP430 family microcontrollers

Unit I RISC Processors 9

RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC18xx microcontroller family, Architecture, Instruction set, ROM, RAM, Timer programming, Serial port programming, Interrupt programming, ADC and DAC interfacing, CCP module and programming.

Unit II CISC Processors 9

RL78 16 BIT Microcontroller architecture, addressing modes, on-Chip memory, ADC, interrupts, MAC unit, Barrel shifter, internal and external clock generation, memory CRC, on chip debug function and self programming.

Unit III MSP430 16 - Bit Microcontroller 9

The MSP430 Architecture, CPU Registers, Instruction Set, addressing modes, the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x. Low power aspects of MSP430 : low power modes, active Vs standby current consumption, FRAM Vs Flash for low power and reliability.

Unit IV Programming and Peripheral Interface using MSP430 Families 9

Memory mapped peripherals, I/O pin multiplexing, Timers, RTC, watchdog timer, PWM control, Analog interfacing and data acquisition, DMA, programming with above internal peripherals using optimal power consumption. Case study: Remote control of air conditioner and home appliances.

Unit V Communication Interface using MSP 430 Microcontroller 9

Serial and parallel communication, synchronous and asynchronous interfaces , Implementing and programming of : UART, I2C and SPI protocol. wireless connectivity : NFC, Zigbee, bluetooth and WiFi. MSP430 development tools. Case study: Implementing WiFi connectivity in smart electric meter.

Total: 45 Periods

TEXT BOOKS:

1. Alaxander G, James M. Conard, " Creating fast, Responsive and energy efficient Embedded systems using the Renesas RL78 microcontroller", Micrium press, USA, Reprinted by S.P Printers, 2011

REFERENCE BOOKS:

1. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. "PIC Microcontroller and Embedded Systems", Pearson Education, 2008.
2. John H. Davies, "MSP 430 Micro controller basics", Elsevier, 2008.

COURSE OUTCOMES:

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

- Discriminate RISC and CISC processors, and work with PIC microcontrollers.
- Work with the 16 bit microcontroller RL78 and design microcontroller based systems for a Real world application.
- Gain design knowledge and concepts on MSP430 family of Microcontroller.
- Design real time systems by deploy the Interfacing peripherals.
- Design and develop microcontroller based smart electronic system and home appliances.

21EEV504	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the working principles of consumer electronic devices
- To introduce the fundamental concepts of electronics and communication in electronic gadgets

Unit – 1 LOUD SPEAKER AND MICROPHONE 9

Loud speaker, Basic Loud speaker,Types of loud speaker- Crystal, Electrostatic ,Dynamic , Permanent Magnet Loudspeakers , Loud speaker system, Multiway system, Microphone, Types of Microphone

Unit – 2 AUDIO SYSTEM 9

AM/FM Basics, Anatomy of a Hi-Fi system , Source Units , Signal Propagation , Stereo Multiplex , Compatibility , Tuner, AM Tuner, FM Tuner, Disc, Mono, Stereo

Unit – 3 VIDEO SYSTEM 9

Element of TV System, Monochrome TV, Television as a system, Color TV, Color TV System, Television Control, Remote Control, Canon Portable Video System, Laservision—Video Disc System, Interactive Video Systems

Unit – 4 ELECTRONIC GADGETS 9

Telecommunication system, Mobile Radio System, VHF/UHF Radio System, Cellular Phone , Types of Mobile phones, Facsimile, Calculator, Digital Clocks, microprocessors, Microcomputers and Microcontrollers

Unit – 5 APPLICATIONS 9

In Car Computers, Microwave Oven, Air Conditioners , Refrigerator , Air Line, Reservation, ATM, Set top box

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the fundamentals of audio and video systems	Understand
CO2	Explain the basic functions of various consumer electronic devices.	Understand
CO3	Apply the basic knowledge in Consumer circuits to design an simple real time electronic devices	Apply
CO4	Apply the knowledge of modulation to determine the parameters of communication system	Apply

CO5	Analyze the different types of audio and video systems	Analyze
CO6	Analyze the real time applications of various electronic devices	Analyze

TEXT BOOK:

1. S.P.Bali, —Consumer Electronics, Pearson Education, 4th impression, 2011.

REFERENCES:

1. R.G. Gupta,—Audio and Video Systems,TataMcGrawHill,2010.
2. R.R. Gulati,—Complete Satellite & Cable Television ,New age International Publisher, 2008
3. Philip Hoff, Consumer Electronics for Engineers, Cambridge University Press ISBN 9780521582070, 1998

19UEE929	PCB DESIGN	L	T	P	C
	(Integrated Course)	2	0	2	3

Unit I Introduction to Printed circuit board **9**

Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork.

Unit II Design rules for PCB **9**

Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

Unit III Introduction to Electronic design automation(EDA) tools for PCB designing **9**

Brief Introduction of various simulators,SPICE and PSPICE Environment, Selecting the Components Footprints as per design, Making New Footprints, Assigning Footprint to components, Net listing, PCB Layout Designing, Auto routing and manual routing. Assigning specific text (silkscreen) to design, Creating report of design, creating manufacturing data (GERBER) for design.

Unit IV Introduction printed circuit board production techniques **9**

Photo printing, film-master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching machines, Solders alloys, fluxes, soldering techniques, Mechanical operations.

Unit V PCB Technology Trends and PCB design for EMI/EMC **9**

Multilayer PCBs. Multi wire PCB, Flexible PCBs, Surface mount PCBs, Reflow soldering, Introduction to High-Density Interconnection (HDI) Technology. Subsystem/PCB Placement in an enclosure, Filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Electronic waste; Printed circuit boards Recycling techniques, Introduction to Integrated Circuit Packaging and footprints, NEMA and IPC standards.

Total: 30 + 30 = 60 Periods

TEXT BOOKS:

1. Printed circuit board design ,fabrication assembly and testing By R. S. Khandpur, Tata McGraw Hill 2006

REFERENCE BOOKS:

1. Printed circuit Board Design and technology, Walter C. Bosshart

2. Printed Circuits Handbook, Sixth Edition, by Clyde F. Coombs, Jr, Happy T. Holden, Publisher: McGraw-Hill Education Year: 2016

3. Complete PCB Design Using Or CAD Capture and PCB Editor, Kraig Mitzner Bob Doe Alexander Akulin Anton Suponin Dirk Müller, 2nd Edition 2009.
4. Introduction to System-on-Package, Rao R Tummala &Madhavan Swaminathan, McGraw Hill, 2008.
5. EMC and Printed circuit board ,Design theory and layout, Mark I Montrose IEEE compatibility society.
6. Flexible Printed circuit board Design and manufacturing ,By Robert torzwell
7. Web-based Current literature.

COURSE OUTCOMES:

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

- Understand basics of PCB designing.
- Apply advance techniques, skills and modern tools for designing and fabrication of PCBs.
- Apply the knowledge and techniques to fabricate Multilayer, SMT and HDI PCB.
- Understand concepts of Packaging.
- Apply the recent Trends in PCB design for EMI/EMC.

19UEE930	PLC AND SCADA APPLICATIONS (Integrated Course)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- PLC architecture and its components
- Ladder logic diagrams for given applications using basic and advanced Instructions
- SCADA architecture operation and applications

Unit I Programmable Logic Controller (PLC) Basics 10

Definition – Overview of PLC systems – Input and 0utput modules – Power supplies – Isolators – General PLC programming procedures – Programming on-off outputs – Auxiliary commands and functions – Creating ladder diagrams from process control descriptions – Register basics – Timer functions – Counter functions.

Unit II PLC Intermediate and Advanced Functions 10

Arithmetic functions – Number comparison functions – Skip and MCR functions – Data move systems – PLC advanced intermediate functions – Utilizing digital bits – Sequencer functions – Matrix functions – Alternate programming languages – Analog PLC operation – Networking of PLC – PID control of continuous processes – PLC installation – Troubleshooting and maintenance – Controlling a Robot.

Unit III Introduction to SCADA and its System Components 10

SCADA: Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions. Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server, Various SCADA Architectures, advantages and disadvantages of each system, single unified standard architecture IEC 61850 SCADA.

Total: 30 Periods

List of Experiments (30 Periods)

1. Design and implement logic gates and bit level logic ladder diagram program using PLC.
2. Design and develop Parking Lot automatic Vehicle counting with the help of Counter Ladder Diagram program using PLC.
3. Design and implement arithmetic and logic instruction ladder diagram program using PLC.
4. Design and implement ladder logic for bottle filling system using PLC.
5. Design and implement ladder logic for traffic signal control using PLC.
6. Design and implement ladder logic for mixing, heating and filling process using PLC.
7. Design and implement ladder logic program for stepper motor speed control system using

PLC.

8. Design and implement ladder logic program for water level control system using PLC.

Total: 60 Periods

TEXT BOOKS:

1. John. W. Webb and Ronald A. Reis, " Programmable Logic Controllers – Principles and Applications ",Fifth Edition,2002.

2. Frank D. Petruzella, "Programmable Logic Controllers ",Fourth Edition,2011.

REFERENCE BOOKS:

1. Krishna Kant, "Computer based Industrial Control", Prentice Hall of India, 5th Edition, 2009.

2. Curtis D.Johnson, "Process control InstrumentationTechnology", Pearson Education, 2006. 3. Stuart A Boyer, "SCADA supervisory control and data acquisition", 4th Edition, 2009.

4. Gordan Clark and Deem Reynders, "Practical Modem SCADA Protocols", 2004.

COURSE OUTCOMES:

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

- Illustrate the components and their functions of the PLC. [Understand]
- Create ladder logic diagrams using PLC for a given application. [Create]
- Explain the components and its operation of SCADA system. [Understand]
- Apply the knowledge of SCADA in power system operation and control. [Apply]
- Develop PLC and SCADA for real time applications. [Apply].

19UEE931	ANALOG AND MIXED MODE VLSI DESIGN	L	T	P	C
		3	0	0	3

Unit I Introduction and Basic MOS Devices **9**

Challenges in analog design-Mixed signal layout issues- MOS FET structures and characteristics- large signal model – small signal model- single stage Amplifier-Source follower-Common gate stage – Cascode Stage

Unit II Submicron Circuit Design **9**

Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design, Delay Elements – Adders- OP Amp parameters and Design

Unit III Data Converters **9**

Characteristics of Sample and Hold- Digital to Analog Converters- architecture-Differential Non linearity-Integral Non linearity- Voltage Scaling-Cyclic DAC-Pipeline DAC-Analog to Digital Converters- architecture – Flash ADC-Pipeline ADC-Differential Non linearity-Integral Non linearity

Unit IV SNR in Data Converters **9**

Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC

Unit V Switched Capacitor Circuits **9**

Resistors, First order low pass Circuit, Switched capacitor Amplifier, Switched Capacitor Integrator.

Total: 45 Periods

TEXT BOOKS:

1. Razavi B., “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2001
2. R.Jacob Baker, Harry W.Li & David E.Boyce,“CMOS Circuit Design Layout and Simulation”, PHI, 2002

REFERENCE BOOKS:

1. Razavi B., “RF Microelectronics”, Prentice Hall, 1998.
2. E. Allen, Douglas R. Holberg, “CMOS Analog circuit Design”.
3. Vineetha P.Gejji Analog and Mixed Mode Design - Prentice Hall, 1st Edition , 2011
4. JeyaGowri Analog and Mixed Mode Design- Sapna publishing House 2011

COURSE OUTCOMES:

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

- Learn about the design of CMOS-VLSI Circuits using hand calculations

- Study the applications of CMOS circuits, their front end and back end designs
- Model the CMOS circuits
- Simulate them for IC solutions.

19UEE932 **SMART GRID**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To explain Smart Grid technologies, distribution automation, information and communication Technologies
- To summarize tools and techniques for smart grid
- To familiarize with different smart meters and control of smart grid system.

Unit I Introduction to Smart Grid 4

Need for smart grid , Smart Grid definitions , Benefits of smart grid , Overview of enabling technologies in smart grid ,vision of smartgrid .International experience Smart grid demonstration and deployment efforts ,Indian Smart Grid, Key Challenges for Smart Grid.

Unit II Smart Grid Architecture 8

Components and Architecture of Smart Grid Design, Standards for smart Grid ,Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs, Transmission Automation, Distribution Automation, Renewable Integration.

Unit III Tools and Techniques for Smart Grid 8

Computational Techniques – Static and Dynamic Optimization Techniques – Computational Intelligence Techniques –Evolutionary Algorithms – Artificial Intelligence techniques.

Unit IV Smart Meters and Advanced Metering Infrastructure 7

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED) & their application for monitoring & protection.

Unit V Distribution Technologies and Communication Technologies 9

Introduction to Renewable Energy Technologies, Micro grids Storage Technologies .Electric Vehicles and plug–in hybrids. Environmental impact and Climate Change Economic Issues. Introduction to Communication Technology .Synchro Phasor Measurement Units (PMUs) ,Wide Area Measurement Systems (WAMS).

Unit VI Control of Smart Power Grid System 9

Load Frequency Control (LFC) in Micro Grid System ,Voltage Control in Micro Grid System, Reactive Power Control in Smart Grid.Case Studies and Test beds for the Smart Grids.

Total: 45 Periods

TEXT BOOKS:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jian zhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications",1st Edition, Wiley & Sons Ltd , United States,

2012.

REFERENCE BOOKS:

1. "Smart Grid primer", 1st Edition, Power grid Corporation of India limited, India, 2013.
2. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", 1st Edition, CRC Press , India, 2012.

COURSE OUTCOMES:

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

- Understand the features of small grid in the context of Indian grid.[(Understand]
- Interpret the role of automation in transmission and distribution. [Apply]
- Identify evolutionary algorithms for smart grid. [Analyze]
- Categorize different smart meters and advanced metering infrastructure. [Analyze]
- Justify the communication technology used in smart grid. [Evaluate]
- Formulate the control strategy for smart power grid system. [Create]

CO – PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	2	1										
CO3	3	2	1	1								
CO4	3	2										
CO5	3	2	1	2								
CO6	3	2	2	3								

19UEE933	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To summarize the power system operation and control
- To impart knowledge on real power-frequency control and reactive power-voltage control
- To introduce the concepts of computer control of power systems

UNIT I INTRODUCTION 9

System load variation - load characteristics - load curves and load-duration curve (daily, weekly and annual) - load factor - diversity factor. Importance of load forecasting and simple techniques of forecasting. An overview of power system operation and control.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - Speed-Load characteristics – load sharing between two synchronous machines in parallel. Control area concept LFC control of a single-area system and two-area system.

UNIT III REACTIVE POWER–VOLTAGE CONTROL 9

Basics of reactive power control. Excitation systems - generation and absorption of reactive power, Relation between voltage, power and reactive power at a node - Methods of voltage control - tap-changing transformer - SVC (TCR + TSC) and STATCOM – secondary voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Introduction – incremental cost curve - co-ordination equations without loss and with loss, solution by direct method. (No derivation of loss coefficients). Statement of Unit Commitment problem - Priority-list methods.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control of power systems - Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Concept of State Estimation - State transition diagram showing various state transitions and control strategies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Summarize the technological advancements in computer control strategies for enhancing the security of power system. [Understand]
- Apply the knowledge of load characteristics and load forecasting for the planning of power system operation and control. [Apply]
- Model typical excitation system and select appropriate compensating device for voltage control. [Apply]
- Analyze the static and dynamic load frequency control loops for controlled and uncontrolled power system cases. [Analyze]
- Analyze the parallel operation of synchronous machines by examining their speed load characteristics [Analyze]
- Choose appropriate methods for economic load sharing to enhance economic operation of power system for the benefit of the society. [Evaluate]

TEXT BOOKS:

1. Allen. J. Wood. And Bruce F. Wollenberg, " Power Generation, Operation and Control ", John Wiley & Sons,2013.
2. Chakrabarti, Halder, " Power System Analysis: Operation and Control ", Prentice Hall of India, Third edition, 2010.

REFERENCE BOOKS:

1. Kothari D.P. Nagrath I.J, "Modern Power System Analysis ", Tata McGraw Hill Publishing Company Limited, Third Edition, 2003.
2. Grigsby L.L., "The Electric Power Engineering, Hand Book ", CRC Press & IEEE Press, 2001.
3. Hadi Saadat, " Power System Analysis",11th Edition, 2007.
4. Kundur P., " Power System Stability and Control ", MC Craw Hill Publisher, 2006.

CO-PO MAPPING

Course Outcomes	Program Outcomes (POs)												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1					1							3		
CO2	3										2			
CO3	3		1											
CO4		3												
CO5		3												
CO6				3		3					3			

19UEC959 PRINCIPLES OF COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To have understanding about different types of Analog and digital Communication systems
- To understand the knowledge of information theory in communication system.
- To know the spread spectrum modulation techniques and different multiple access methods.
- To impart the knowledge of satellite and optical fiber communication

Unit I Analog Communication 10

Introduction: Overview of Communication system, Communication channels, Need for modulation, generation of Amplitude Modulation – DSB,DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – generation and reception : NBFM & WBFM.

Unit II Digital Communication 10

Pulse modulations – concepts of sampling and sampling theorems, PAM, PWM, PPM, quantization and coding: PCM, DM, ADM, DPCM, Modulation schemes– ASK, FSK,PSK, BSK, QPSK, QAM, MSK, GMSK.

Unit III Information Theory 9

Uncertainty, Information and entropy, source coding theorem, Discrete Memory less channels, Mutual Information, Channel capacity, Channel coding theorem, Differential entropy, Information capacity theorem, Linear block codes, cyclic codes, convolutional codes.

Unit IV Spread Spectrum and Multiple Access Techniques 8

Spread Spectrum techniques:PN Sequences- properties- Design principles- Direct sequence (DS) and Frequency Hopping (FH) spread spectrum –Multiple Access techniques -FDMA, TDMA, CDMA, SDMA.

Unit V Recent Trends in Communication Systems 8

Recent trends in communication: Mobile Telephone communication-cellular concept, Optical communication, RADAR system, Satellite communication.

Total: 45 Periods

TEXT BOOKS:

1. WayneTomashi,"Electronic Communications systems", Pearson –Prentice hall publications, 5th edition, 2000.

2. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication" Oxford University

2. Press, 5th edition, 2018.

REFERENCE BOOKS:

1. Simon Haykin and Michael Moher, “Communication Systems” John Wiley & Sons, Fifth Edition, 2016.

2. Herbert Taub, Donald L Schilling, and Goutam Saha, “Principles of Communication Systems” McGraw-Hill, Third Edition, 2008.

COURSE OUTCOMES:

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

- Apply the knowledge of mathematical theory to characterize and construct analog Modulation schemes in time and frequency domain. (Apply)
- Evaluate the performance of different digital modulation techniques in terms of bandwidth, Signal to noise ratio and probability of error. (Evaluate)
- Apply the knowledge of line coding techniques and information theory for efficient Base band signalling and construction of efficient source and error control coding scheme.(Apply)
- Analyze the performance of spread spectrum system in the presence of interference and Multipath propagation. (Analyze)
- Design analog and digital communication system for a given specification. (Create)
- Summarize the recent trends in communication system. (Understand)

19UEC960 FIBER OPTIC COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To have understanding about different types of Analog and digital Communication systems
- To understand the knowledge of information theory in communication system.
- To know the spread spectrum modulation techniques and different multiple access methods.
- To impart the knowledge of satellite and optical fiber communication

Unit I Optical Fiber and their properties 9

Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations), single mode fiber, cutoff wave length, and mode filed diameter. Wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, loss and bandwidth.

Unit II Transmission Characteristics of Optical Fiber 9

Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion, dispersion and pulse broadening, dispersion shifted and dispersion flattened fibers. General Overview of nonlinearties , Stimulated Raman Scattering, Stimulated Brillouin Scattering , Self Phase modulation , Cross –Phase modulation , Solitons. Measurements of attenuation, dispersion and OTDR.

Unit III Sources and Detectors 9

Opticalsources:LightEmittingDiodes-LEDstructures-surfaceandedgeemitters,internal- quantum efficiency ,injection laser diode structures-comparison of LED and ILD Optical Detectors: PIN Photo detectors Avalanche photodiodes, construction, characteristics and properties, Comparison of performance, Photo detector noise– Noise sources ,Signal to Noise ratio, Detector response time.

Unit IV Fiber Optic Components 9

Fiber fabrication (VAD,MCVD), fiber joints, fiber connectors, splices Couplers, multiplexers, filters, fiber gratings, Fabry Perot filters, switches and wavelength converters, Optical amplifiers, basic applications and types, semiconductor optical amplifiers, EDFA.

Unit V Optical Link 9

Introduction, Point to point links, system considerations, link power budget, and rise time budget. RF over fiber, key link parameters, Radio over fiber links, microwave photonics.

Total: 45 Periods

TEXT BOOKS:

1. Optical Fiber Communication – Gerd Keiser, 4th Ed., MGH, 2008.

2. Optical Fiber Communications– – John M. Senior, Pearson Education. 3rd Impression, 2007.

REFERENCE BOOKS:

1. Fiber optics communications-Harold Kolimbiris

2. Introduction to optical fibers, Cheri, McGraw Hill.

3. An introduction to fiber optics, A. Ghatak and K.Thyagrajan, Cambridge Univ, press 10

4. Optical fiber communication and sensors-M. Arumugam Agencies, 20002 optic sensors.

5. Fiber optic communication– Joseph C Palais: 4th Edition, Pearson Education.

COURSE OUTCOMES:

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

- Apply the knowledge of transmission characteristics of light signal to compute various losses in optical fibers. **(K3- Apply)**
- Apply the knowledge of optical sources and detectors to find their suitability for different applications. **(K3- Apply)**
- Apply laser theory for the selection of lasers for a specific Industrial and medical application. **(K3- Apply)**
- Analyze and deign optical fiber link with encapsulation of different system components. **(K4- Analyze)**
- Analyze the different optical components for suitable applications.**(K4- Analyze)**
- Understand the concept of optical fiber and their properties.**(K2-Understand)**

19UPH955	FUNDAMENTALS OF NANO SCIENCE	L	T	P	C
	(For EEE)	3	0	0	3

OBJECTIVES:

- To introduce the basics of Nanomaterials.
- To explain the synthesis methods of Nanopowders.
- To give an idea about Nanophase materials.
- To give knowledge about the Nanoscale properties.
- To familiarize the applications of Nanotechnology in Electrical and electronics Industry**.**

UNIT I NANODIMENSIONAL MATERIALS 9

Introduction to Nanotechnology: Characteristic scale for quantum phenomena, nanoparticles, nano-clusters, nanotubes, nanowires and nanodots. **Electronic structure:** quantum dots, quantum wires and quantum wells, confinement of electrons energy quantization- Semiconductor nanocrystals, carbon nanotubes, quantum wells.

UNIT II SYNTHESIS OF NANO MATERIALS 9

Synthesis of metallic, semiconducting and oxide nanoparticles – homo and hetero-nucleation growth methods – template-based synthesis (electrochemical, electrophoretic, melt and solution, CVD) –

Gas Phase Synthesis of Nanopowders: – Vapor (or solution) – liquid – solid (VLS or SLS) growth – the need for Gas/vapor state processing – Main Stages of Gas Phase Synthesis – Applicability of the methods-DTA, TGA, DSC (Principle and Applications), Determination of thermo physical parameters.

UNIT III CHARACTERIZATION OF NANOPHASE MATERIALS 9

X-ray sources – wide angle, extended x-ray absorption technique – **Electron microscopy:** Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM), UV-VIS-IR Spectrophotometers, Raman spectroscopy

UNIT IV NANOSCALE PROPERTIES 9

Magnetism:- Magnetic Moment in clusters/Nanoparticles – Magnetic Order – coercivity – Magnetocrystalline Anisotropy – thermal activation and Superparamagnetic effects – Electronics and Optoelectronics:- Quantum Confinement of Superlattices and Quantum Wells – Dielectric Constant of Nanoscale materials.

UNIT V NANOTECHNOLOGY IN ELECTRICAL AND ELECTRONICS INDUSTRY 9

Advantages of nano electrical and electronic devices –Electronic circuit chips – Lasers - Micro and Nano Electromechanical systems – Sensors, Actuators, Optical switches, Bio-MEMS – Batteries - Fuel cells and Photo-voltaic cells – Electric double layer capacitors – Lead-free solder – Nanoparticle coatings for electrical products .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Discuss the fundamentals of Nanoparticles. [Understand]
- Explain the synthesis methods of Nanopowders. [Understand]
- List the properties of Nanoscale properties. [Understand]
- Summarize the characterization of Nano materials. [Understand]
- Outline the applications of nanotechnology. [Understand]

TEXT BOOKS :

1. "Introduction to NanoScience and NanoTechnology" K.K.Chattopadhyay, A.N.Banerjee,PHI learning private limited, New Delhi,2009.
2. "Textbook of Nanoscience and Nanotechnology",Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J.SPRINGER and Co-publication with Universities Press (India) Pvt. Ltd.2013, XII Edition.

REFERENCE BOOKS:

1. C. N. R. Rao, A. Muller, A. K. Cheetham, "The Chemistry of Nanomaterials Synthesis, Properties and Applications', Volume 1, Wiley-VCH, Verlag GmbH, Germany (2004).
2. C. Bre´chignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer Berlin Heidelberg, Germany (2006).
3. Guozhong Cao, " Nanostructures & Nanomaterials Synthesis, Properties G;Z: Applications", World Scientific Publishing Private, Ltd., Singapore (2004).
4. Bharat Bhushan, "Springer Handbook of Nanotechnology", Barnes & Noble (2004).

19UEE971	NON-CONVENTIONAL ENERGY RESOURCES AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain concept of various forms of renewable energy
- To introduce the division aspects and utilization of renewable energy sources for both domestics and industrial applications
- To discuss the environmental and cost economics using renewable energy sources

UNIT I INTRODUCTION 9

World energy use – Reserves of energy resources – Environmental aspects of energy utilization – Renewable energy scenario in India – Potentials – Achievements – Applications.

UNIT II SOLAR ENERGY 9

Solar thermal – Flat plate and concentrating collectors – Solar heating and cooling techniques – Solar desalination – Solar cooker – Solar thermal power plant – Solar photo voltaic conversion – Solar cells – PV applications.

UNIT III WIND ENERGY 9

Wind data and energy estimation – Types of wind energy systems – Performance – Details of wind turbine generator – Safety and Environmental Aspects.

UNIT IV BIOMASS ENERGY 9

Biomass direct combustion – Biomass gasifier – Biogas plant – Ethanol production –Bio diesel – Cogeneration –Biomass applications.

UNIT V OTHER RENEWABLE ENERGY SOURCES 9

Tidal energy – Wave energy – Open and closed OTEC Cycles – Small hydro – Geothermal energy – Fuel cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the Environmental aspects of energy utilization and Renewable energy scenario. [Understand]
- Illustrate the various applications of solar energy. [Understand]
- Discuss the concepts of types and performance of wind energy systems. [Understand]
- Analyze the processes of biomass. [Analyze]
- Analyze the process of other possible renewable energy sources. [Analyze]

TEXT BOOKS:

1.Rai G.D., “Non Conventional Energy Sources”, Khanna Publishers,1999.

2.Khan B.H., “ Non Conventional Energy Resources”, Tata McGraw Hill Publishing Company Ltd., 2006.

REFERENCE BOOKS:

1. Godfrey Boyle, “ Renewable Energy, Power for a Sustainable Future ”, Oxford UniversiPress, 1996.
2. Twidell J.W. and Weir, “Renewable Energy Sources ”, EFN Spon Ltd, 1996
3. Tiwari, “ Solar Energy – Fundamentals Design, Modelling and applications”,Narosa Publishing House, 2002.
4. Freris L.L., “ Wind Energy Conversion systems ”, Prentice Hall, 1990.
5. Sukhatme S.P., “ Solar Energy ”, Tata McGraw Hill Publishing Company Ltd., 1997.

19UEE972	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.

UNIT I ELECTRIC VEHICLES 9

Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II BATTERY 9

Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES 9

Motor and Engine rating, Requirements, DC machines, Three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN 9

Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES 9

Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the concepts of Electrical vehicles. [Understand]
- Discuss the various parameters of battery. [Understand]
- Analyze the performance of DC and AC machines used for Electric and Hybrid Vehicles. [Analyze]
- Explain the concepts electrical vehicle drive system. [Understand]
- Analyze the performance of various hybrid Electric vehicles. [Analyze]

REFERENCES:

1. Iqbal Hussain, “Electric & Hybrid Vechicles – Design Fundamentals”, Second Edition, CRC

Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
4. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001

19UEE973	SOLAR POWER PLANTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain concept of various power cycles involved in the solar power plants
- To outline the variety of solar systems used to collect solar energy
- To summarize basic economics of solar power plants

UNIT I INTRODUCTION 8

Power Plant Scenario - Classification, Basic Principles and Features - Comparison and selection Criteria.

UNIT II SOLAR POWER CYCLES 9

Vapour cycles. Organic cycles. Combined cycles. Binary Cycles. Strilng and other cycles.

UNIT III SOLAR THERMAL POWER PLANTS 10

Colector, Receiver, Energy Transfer Power cycles - Tower, Trough and Dish Systems – Concentrating Dish Systems - Concentrating Linear Fresnel Reflectors - Combined and Binary Cycles – Solar Chimneys - Hybrid Systems.

UNIT IV SOLAR PV POWER PLANTS 10

National / International PV Power Programmes - Photovoltaic Power Systems - System Integration - Energy Storage - Power Electronics - Stand-Alone Systems - Grid-Connected Systems - Concentrating Photovoltaic (CPV) - Electrical Performance.

UNIT V ECONOMICS OF POWER PLANTS 8

Methods of fixing power tariff - Simple Methods to Calculate the Plant Economy - Life Cycle Cost - Payback Period - Economic Analysis for the Selection of Alternative Decisions and the future of the Power Plants.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- Explain the operation and features of various power plants. [Understand]
- Analyze the various solar power cycles. [Analyze]

- Explain the various components and their functions used for solar thermal power plants. [Understand]
- Discuss the operation of standalone and Grid connected solar PV power plants. [Understand]
- Analyze the cost estimation and economic factors of power plants. [Analyze]

REFERENCEBOOKS

1. Dufie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, New York, 2006.
2. Kosuke Kurokawa (Ed.), Energy from the Desert – Feasibility of very large scale photovoltaic power generation systems, James and James 2003.
3. Sukhatme S.P., Solar Energy, Tata McGraw Hils P Co., 3rd Edition, 2008.
4. C.J. Winter, R.L. Sizman, L.L. Vant-Hul, Solar Power Plants, Springer- Verlag Berlin and Heidelberg GmbH & Co. K, 201.
5. Tomas Markvart, Solar electricity, John Wiley & Sons, 2003.
6. Jorg Schlaich, The solar chimney: Electricity from the sun, Edition Axel Menges, 2005.
7. John McBrewster , Frederic P. Miler, Agnes F. Vandome (Eds.) Renewable Energy Commercialization, Alphascript Publishing 2009.

19UEE974	MEMS	L	T	P	C
		3	0	0	3

OBJECTIVIES:

- To impart knowledge on the fundamental science and engineering relevant to fabrication of miniature size systems
- To explain the relationship between nano/microstructure, characterization, properties and processing and design of materials
- To discuss the possess knowledge of sensors and actuators

UNIT I INTRODUCTION **9**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micro magnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , coustic, Tactile and Flow sensors

UNIT IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micromachining processes – Structural and Sacrificial Materials – Acceleration of

sacrificial Etch – Striations and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Select appropriate materials for design and construction of micro electro mechanical system. [Apply]
- Describe the operation of electrostatic sensors and actuators. [Understand]
- Explain the operation of Piezo-resistive sensors and actuators. [Understand]
- Compare the various types of etching methods. [Understand]
- Distinguish the operating principles of polymer and optical MEMS. [Understand]

TEXT BOOKS:

1.Chang Liu, “Foundations of MEMS”, Pearson Education Inc., 2006.

2. Stephen Beeby and Graham Ensell, “ MEMS Mechanical sensors”, Artech House,INC,2004..

REFERENCE BOOKS:

1. NadimMaluf, “ An introduction to Micro electro mechanical system design”, Artech House, 2000.

2. Mohamed Gad-el-Hak, “ The MEMS Handbook”, CRC press Baco Raton, 2000

3. Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture”, Tata McGraw Hill, New Delhi, 2002.

4. Julian w. Gardner, Vijay k. varadan and Osama O. Awadelkarim, “ Micro sensors MEMS and smart devices”, John Wiley & son Ltd,2002

5.James J.Allen, “Micro electro mechanical system design”, CRC Press, 2005

19UEE975	PRINCIPLES OF ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on

- Historical development and Laws of robotics.
- Concept of various kinds of actuators, sensors and vision systems of robots.
- Robot programming and path planning.
- Recent advancement in Robotics.

UNIT I INTRODUCTION 9

Automation and Robotics, laws of robotics, Robot Definitions, Robotic Systems and Robot Anatomy – Link – Joint – manipulator – Wrist – End effector – Actuators – Sensors – Controller, Classification of robots.

UNIT II ROBOT ACTUATORS AND POWER TRANSMISSION SYSTEM 9

Robot drive mechanisms - Hydraulic and Pneumatic systems - Electric Drives – DC PMMC motor and Brushless DC Motor – Servomotor – Stepper Motor, Mechanical Transmission method – Gear Transmission – Belt Drive – Cables – Roller Chains, Rotary to Rotary motion conversion - rotary to linear motion conversion mechanisms – Rack and pinion drives, Variable Speed Arrangement, Robot end effectors - Types.

UNIT III ROBOT SENSORS AND VISION SYSTEM 9

Sensor Characteristics, Review of Sensors - Potentiometers – Encoders – LVDT –– Resolvers - Tachogenerators – Strain Gauge sensors, Position Sensors, Velocity Sensors, Proximity Sensors, Touch sensors, Accelerometers - Gyroscope - Laser Range Finder - Force and torque sensors – Resistance sensor, Robot Vision systems: Block Diagram of Robot Vision System – Image Capture Cameras – vidicon and Solid state – Lighting technique and devices – Image representation – Image Segmentation - Feature extraction - Object Recognition.

UNIT IV ROBOT KINEMATICS 9

Rotation Matrix, Composition of Rotation matrices - Euler Angles - Homogeneous Transformations for the manipulator - The forward and inverse problem of manipulator kinematics - Motion generation - Manipulator dynamics - Jacobian in terms of D-H matrices – Controller architecture.

UNIT V ROBOT CONTROL AND APPLICATIONS 9

Path Planning – Point-To-Point Motion – Motion Through sequence of Points, Block Diagram of Robot control System, Motion Control – Computed Torque Control, Force Control – Indirect Force control.

Applications: Flexible Manufacturing Systems concept - Automatic feeding lines, automatic inspection – Material transfers: Machine loading and unloading - Processing operations - Assembly and inspection – Automatic welding Robot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the Laws of Robotics. [Understand]
- Analyze the concept of various kinds of actuators and power transmission system. [Analyze]
- Explain various Robot sensors and vision system. [Understand]
- Analyze various Robot kinematics. [Analyze]
- Explain the Robot control and applications. [Understand]

TEXTBOOKS:

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, “Industrial Robotics: Technology, Programming, and Applications 2nd Edition”, Tata-Mcgraw Hill Publisher, 2012.
2. Ming Xie, “Fundamentals of Robotics Linking Perception To Action”, World Scientific Publishing Co. Pte. Ltd, Singapore, 2003.

19UEE976	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an introduction to the emerging area of intelligent control and optimization.
- To offer a basic knowledge on expert systems, fuzzy logic systems, artificial neural networks and optimization techniques.
- To afford hands on training in Matlab-Neural Network toolbox, Matlab - GA toolbox and Matlab fuzzy-logic toolbox.

UNIT I INTRODUCTION 9

Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning system, rule-based systems, the AI approach.

UNIT II ARTIFICIAL NEURAL NETWORKS 9

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Back propagation algorithm, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller.

UNIT III GENETIC ALGORITHM AND OTHER OPTIMIZATION TECHNIQUES 9

Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters, Solution of typical control problems using genetic algorithm. Concepts of tabu search, ant-colony and PSO.

UNIT IV FUZZY LOGIC SYSTEM 9

Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning, Introduction to fuzzy logic modeling and control, Fuzzification, inferencing and defuzzification, Fuzzy knowledge and rule bases, Fuzzy modeling and control schemes for nonlinear systems, Self-organizing fuzzy logic control.

UNIT V APPLICATIONS 9

GA application to power system optimization problems: Economic Dispatch problem, Unit Commitment problem, Optimal Capacitor placement in distribution systems. Identification and control of linear and non-linear dynamic systems using Matlab-Neural Network toolbox, Optimization using Matlab - GA toolbox, Implementation of fuzzy logic controller using Matlab – fuzzy logic toolbox.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Explain the Architecture of AI. [Understand]
- Analyze the concept of Artificial neural networks. [Analyze]
- Explain the Genetic algorithm and other optimization techniques. [Understand]
- Analyze Fuzzy Logic System. [Analyze]
- Explain the GA application to power system optimization problems. [Understand]

TEXTBOOKS:

1. Sivanandam S.N., Deepa S.N., “Principles of Soft Computing”, Wiley India Pvt. Ltd., Reprint 2012.
2. Kosko B., “Neural Networks And Fuzzy Systems”, Prentice-Hall of India Pvt. Ltd., 1994.
3. Donald A. Waterman, “A Guide to Expert Systems”, Addison-Wesley Publishers.

REFERENCE BOOKS:

1. Jacek.M.Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1999.
2. Klir G.J., Folger T.A., “Fuzzy sets, uncertainty and Information”, Prentice-Hall of India Pvt. Ltd., 1993.
3. Zimmerman H.J., “Fuzzy set theory-and its Applications”, Kluwer Academic Publishers, 1994.
4. Driankov, Hellendroon, “Introduction to Fuzzy Control”, Narosa Publishers.
5. Goldberg D.E., “Genetic algorithms in Search, Optimization and Machine learning”, Addison Wesley, 1989.
6. Padhy N.P., “Artificial Intelligence and Intelligent System, Oxford University Press, 2005.

19UGM954	SMART BUILDINGS	L	T	P	C
	OFFERING DEPARTMENTS: EEE & CIVIL	3	0	0	3

UNIT I INTELLIGENT BUILDINGS **9**

Concept, Definition, intelligent Architecture and structure, evaluation of intelligent buildings, IB assessment criteria – intelligent homes

UNIT II ENERGY MANAGEMENT IN DESIGN **9**

Natural building design consideration - Energy efficient design strategies - Contextual factors - Longevity and process Assessment -Renewable energy sources and design- Advanced building Technologies - Smart buildings.

UNIT III ENERGY MANAGEMENT IN SERVICES **9**

Energy in building design - Energy efficient and environment friendly building – Thermal phenomena - thermal comfort - Indoor Air quality - passive heating and cooling systems - Energy Analysis - Active HVAC systems -Preliminary Investigation - Energy audit - Types of energy audit - Energy flow diagram - Energy consumption/ Unit production – Identification of wastage -Priority of conservative measures - Maintenance of management programme.

UNIT IV BUILDING ENERGY CONSERVATION TECHNOLOGIES **9**

Standards of energy efficiency in buildings. Trends in energy consumption. Energy audit: evaluation of energy performance of existing buildings, use of computer models, impact of people behaviour. Energy efficiency measures in buildings: approaches, materials and equipments, operating strategies, evaluation methods of energy savings. Optimum selection of energy sources. Air-to-air energy recovery.

UNIT V CONTROL SYSTEMS IN BUILDINGS **9**

Introduction to automatic control systems, control issues related to energy conservation, interior air quality and thermal comfort in buildings – Ventilation. Classification of HVAC control system: selection and size of sensors, actuators and controllers. Practical HVAC control system Designing and turning controllers – Building automation systems, design for security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course, the students will be able to

- Describe the concepts and evaluation criteria for Intelligent buildings (Understand)
- Explain the energy efficient design strategies (Understand)
- Summarise the energy management techniques in various building services and perform energy audits. (Understand)
- Describe and suggest various energy efficiency measures in buildings. (Understand)
- Intricate the automatic control systems and Building automation systems (Understand)

TEXT BOOKS:

1. Jim Sinopoli, “Smart buildings”, Smart building publisher: 2006, ISBN 0978614402, 9780978614409
2. Nilesh Y. Jadhav, “Green and Smart Buildings”, Springer Singapore Publisher: 2016.

REFERENCES:

1. James Sinopoli, “Advanced Technology for Smart Buildings”, Artech House, 2016
2. James Kachadorian, “Passive Solar House: The Complete Guide to Heating and Cooling Your Home” Chelsea Green Publishing; Revised and expanded second edition,2006
3. James M. Sinopoli, Smart Buildings Systems for Architects, Owners and Builders Publisher Butterworth-Heinemann, 2009

19UGM955 **ELECTRIC VEHICLES** **L T P C**
(OFFERING DEPARTMENTS: EEE & MECH) **3 0 0 3**

UNIT I Hybrid and Electric Vehicles (HEV): History Overview and Modern Applications 9

Ground vehicles with mechanical powertrain and reasons for HEV development - HEV configurations and ground vehicle applications - . Advantages and challenges in HEV design

UNIT II Power Flow and Power Management Strategies in HEV 9

Mechanical power: generation, storage and transmission to the wheels - Electric power: generation, storage and conversion to mechanical power - Hydraulic power: generation, storage and conversion to mechanical power - Energy storage/conversion and thermodynamic relations

UNIT III Electric Drives & Power Electronics in Hybrid Electric Vehicles 9

DC-Brushed and brushless drives: principles of design, operation, math modeling and control - Shunt Drives - Series Drives - Compound Drives - Thermal analysis of electric drives in various vehicle applications. Rectifiers - Buck convertor - Voltage source inverter - Current source inverter - DC-DC convertor

UNIT IV Vehicle Dynamics Fundamentals for HEV Modeling and Wheel-Electric Drive, Suspension System Design 9

Various strategies for improving vehicle energy/fuel efficiency - Vehicle chassis mathematical model in various operation conditions (steady motion, acceleration, regenerating braking, coasting, moving up and down a hill) Gear trains in wheel-electric drives - Mechatronic design of wheel-electric drives - Suspension design for wheel-electric drives Wheel/Tire-terrain interactive dynamics - Inverse dynamics-based control.

UNIT V Batteries and Energy Storages 9

Battery characterization, math modeling and designs-. Battery sizing for various vehicle applications - Battery monitoring and charging control - Combination of batteries and ultra capacitors - Fuel cells: principles of operation, design, modeling - Fuel cell storage system - Strategy for controlling hybrid fuel cell system- Flywheel energy storage characterization - Hydraulic accumulator characterization.

TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. Chris Mi.M, Abdul Mansoor and David Wenzhong Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives” Wiley, Jul 2011.
2. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
3. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
5. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001

19UGM956	ELECTRICAL HAZARDS & SAFETY IN HOSPITALS (Interdisciplinary Course: EEE & BIOMED)	L	T	P	C
		3	0	0	3

UNIT I: REVIEW OF BIO-POTENTIAL AND RECORDING **9**

Electrodes as bioelectric transducers : The electrode-electrolyte interface; Specification and selection criteria for electrodes; Surface, needle, implanted electrodes; Polarisable and non-polarisable electrodes; Practical considerations for optimum performance; Reduction of interference, grounding, safety.

UNIT II: ELECTRICAL STIMULATION AND ITS PARAMETERS **9**

Use in generating evoked potentials, and for therapeutic correction (ECT, pacemakers, defibrillation), Safety limits and precautions; Safety: Hazards associated with the use of electrical /electronic instruments; Provisions for safety; Clinical safety norms.

UNIT III: RADIATION HAZARDS & SAFETY **9**

Retorted Potentials and concepts of radiation, Radiation from a small current element. Radiation resistance: Introduction to Electromagnetic Interference and Electromagnetic compatibility, EMI coupling modes, Methods of eliminating interference, shielding, grounding, conducted EMI, EMI testing: emission testing, susceptibility testing.

UNIT IV: HOSPITAL SAFETY **9**

Security & Safety of Hospital -Property, Staff & Patients, Safety precautions, Factors Contributing to Medical Errors: Health Care Reimbursement, Health Care Failure Mode and Effect Analysis (HFMEA).

UNIT V: ELECTRICAL & FIRE SAFETY **9**

Sources of shocks, macro & micro shocks - Hazards, monitoring and interrupting the operation from leakage current - Elements of fire, causes of fire , Action to be taken in case of fire in a Hospital.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. M.J. Aminoff , Electrodiagnosis in Clinical Neurology, 3rd edition, Churchill Livingstone, USA, 1992.
2. J.A. Delisa, H.J. Lee, E.M. Baran, K.S. Lai & N. Spielholz , Manual of Nerve Conduction and Clinical Electrophysiology, 3rd Edition, Academic Press, New York, 1993.
3. Joseph F Dyro “Clinical Engineering Handbook”, Elsevier Publishers, 2004.

REFERENCE BOOKS:

1. Sharon Myers “Patient Safety & Hospital Accreditation - A Model for Ensuring Success”, Springer Publishers, 2012.
2. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentic Hall Inc., Engle wood Cliffs, New Jersy, 1979.
3. Cadick, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel ; Electrical Safety Handbook by John 2005 , McGraw-Hill Professional; 3 edition

19UEE861	WIND FARM DEVELOPMENT AND OPERATION	L	T	P	C
		1	0	0	1

Objectives

- To impart knowledge on wind farm development and operatic

UNIT I INTRODUCTION 4

Introduction to Wind farm Development and Operation: General Principles and Basic Concepts, Techno economic feasibility considerations. Government and Private Utilities, Rules and regulations, Guidelines, Constraints.

UNIT II INSTALLATION AND COMMISSIONING OF WIND TURBINES 5

Land selection, Topography and Survey details, Micrositing and layouts: – Methods and procedures, selection of equipment, Transportation, installation and commissioning Local infrastructure and Power evacuation; Grid quality and reliability.

UNIT III OPERATION AND MAINTENANCE OF WECS 6

Wind electric conversion systems, Operation efficiency of wind turbine, and Preventive, and Breakdown and Predictive maintenances of WECS subsystems, Failure analysis, aging and rehabilitation. Effective operation of wind farms: Concept of central monitoring system, Modern developments and improvements, Systems and Practices followed in other countries. Estimation of energy production, capacity factor, capacity credit and energy credit. Offshore wind farm development and special considerations. Operation and supervision of wind farm.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

- Define the Rules and regulations for the selection of ideal location of WECS
- Explain the Methods and procedures for installation and commissioning of wind turbines
- Analyze the operation of WECS using various indices

REFERENCES:

1. www.windpower.dk
2. T. Burton, Handbook of Wind Energy, John Wiley and Sons

19UEE862	DESIGN OF TOWERS AND BLADES STRUCTURES	L	T	P	C
		1	0	0	1

O B J E C T I V E :

- To impart knowledge on design of towers and blades structure

UNIT I INTRODUCTION **3**

Introduction to Loads: Extreme loads, fatigue loads, earthquake loads, characteristic loads, partial co-efficients, design loads. Types of Towers**:** Lattice, Tubular (self supporting the guyed) and concrete.

UNIT II STRUCTURAL DESIGN OF TOWERS / BLADES AND CHARACTERISTIC **6**

Characteristic material properties, design properties, partial co-efficients, comparison of loads and strength.Design of Lattice Towers**:** Design of members subjected to lateral and axial loads. Stress/strain calculations. Blades: Geometry, webs and spars, design loads, extreme and fatigue stress/strain calculations, materials, deflations.

UNIT III TYPES AND DESIGN OF CONNECTIONS **6**

Types of connections (welded and fastened), design of framed beam connection, seated beam connections, un stiffened, stiffened seat connections, continuous beam-to-beam connections, continuous beam-to-column connections. Blades: Geometry, webs and spars, design loads, extreme and fatigue stress/strain calculations, materials, deflations.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

- Explain the various types of towers and loads of wind turbine
- Design the structure of towers and blades for wind turbine
- Explain the types of connections of towers and blades

REFERENCES*:*

1. Saloman C. G., and Johnson J. E., " Steel Structures – Design and behavior" Harper and Row 1980

2. Dayarathnam p., "Design of Steel Structures", A. H. Wheeler, 1990

3. " Guidelines for Design of Wind Turbines" second edition, DNV- RISO, Denmark

19UEE863 WIND TURBINE BLADES FABRICATION TECHNOLOGY L T P C

1 0 0 1

O B J E C T I V E :

- To impart knowledge on wind turbine blades fabrication technolog

UNIT I ENGINEERING MATERIALS FOR WIND TURBINE BLADES 3

Basic Structural design of rotor blades. Materials of construction of Rotor Blades - composite materials and properties, Fibreglass and carbon fibre reinforcements, Technology of Polymer Matrices- Polyesters, vinyl esters and epoxies.

UNIT II FABRICATION OF WIND TURBINE BLADES 9

Moulds and Tooling for the fabrication of rotor blades. Molding process of composite rotor blades for wind turbines: hand lay up process; resin transfer, resin injection and vacuum infusion process; Prepreg and vacuum bag process. Finishing and assembly aspects of rotor blades.

UNIT III TESTING OF WIND TURBINE BLADES 3

Inspection and quality control methods. Repair and servicing of wind turbine blades.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

- Explain the various materials for wind turbine blades fabrication technology
- Explain the fabrication process of wind turbine blades
- Analyze the testing of wind turbine blades

REFERENCES*:*

1. Saloman C. G., and Johnson J. E., " Steel Structures – Design and behavior" Harper and Row 1980
2. Dayarathnam p., "Design of Steel Structures", A. H. Wheeler, 1990
3. " Guidelines for Design of Wind Turbines" second edition, DNV- RISO, Denmar

19UEE864	SOLAR PHOTOVOLTAIC TECHNOLOGY	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To explain basics of solar photovoltaic systems.
- To know in depth of its types and design of various PV-interconnected systems

UNIT I PHOTOVOLTAIC BASICS **5**

Structure and working of Solar Cells - Types, Electrical properties and Behaviour of Solar Cells – Cell properties and design - PV Cell Interconnection and Module Fabrication - PV Modules and arrays -Basics of Load Estimation.

UNIT II STAND ALONE PV SYSTEMS **5**

Schematics, Components, Batteries, Charge Conditioners - Balance of system components for DC and/or AC Applications - Typical applications for lighting, water pumping etc.

UNIT III GRID CONNECTED PV SYSTEMS **5**

Schematics, Components, Charge Conditioners, Interface Components - Balance of system Components - PV System in Buildings.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

- Explain basics of solar photovoltaic systems.
- Analyze stand alone PV systems
- Explain grid connected PV systems

REFERENCES

1. CS Solanki: Solar Photovotaics – Fundamentals, Technologies and Applications, PHI Learning Pvt. Ltd., 2011.

2. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice-Hall, 2008.

3. Nelson, J The Physics of Solar Cells. Imperial College Press, 2003. Thomas Markvart, Solar Electricit, John Wiley and Sons, 2001.

4. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish (Editors), Applied Photovoltaics, Earthscan, 2008.
5. Michael Boxwell, The Solar Electricity Handbook, Code Green Publishing, UK, 2009.
6. Rik DeGunther, Solar Power Your Home for Dummies, Wiley Publishing Inc, 2008.
7. Photovoltaics: Design and Installation Manual, Published by Solar Energy International.

19UEE865	INDUSTRIAL SAFETY MEASURES	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To acquire knowledge on industrial safety measures

UNIT I FACTORIES ACT – 1948 **7**

Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamilnadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948

UNIT II ENVIRONMENT ACT – 1986 **8**

General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001-No Objection certificate from statutory authorities like pollution control board.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

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

- Explain various factories act
- .Analyze the various environment act

REFERENCES:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000

2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

4. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.

5. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.

6. The Mines Act 1952, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.

19UEE866	ECO PAINT APPLICATION TECHNOLOGY FOR AUTOMOBILE INDUSTRY	L	T	P	C
		1	0	0	1

OBJECTIVES

- To be familiar with the technical terms used in industry.
- To understand the various technologies used in industry.
- To know about the various software being used in Core sector.
- To realize the importance of basic subject knowledge.
- To know about the paint-shop technique used in the car bodies and in two wheelers.

UNIT I PROGRAM RELATED TO AUTOMOBILE INDUSTRY 5

Comprises of motors , sensors, actuators , PLC systems , Network concept, control concept - layout of all levels and the equipment arrangement-Importance of ASU, Oven, Cooling zone-Application of Robotics-Concept of Control Desks, Control panels and field isolators- importance of sensors and its major role-Concept of Humidifier, Dampers and actuators -Heat load calculation -Importance of redundancy and the simple solutions -Cable & cable tray routing, termination etc.

UNIT II DESIGN SOFTWARES USED IN INDUSTRIES 5

Designing software's and its major role in industries- Software related to Control panel design: Busbar system, Relays ,Contactors, MPCB arrangement and wiring - PLC systems & its types: PLC programming, Installation : Cable tray routing and cable calculation Software.

UNIT III VIRTUAL NETWORKING AND CONTROLLING IN AUTOMOBILE INDUSTRIES & ECO-EMOS 5

Latest technology and its implementation -Virtual control concepts and the application of ECO-EMOS –Techniques related to ECO-EMOS- basic knowledge required to learn this software-Paint and final assembly system-Environmental system-Industrial cleaning and automation solutions- Filtration and automation technology- Measurement, adjustment and testing technology.

TOTAL: 15 PERIODS

COURSE OUTCOMES

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

- Develop program related to automobile industry
- Design softwares used in industries
- Analyze virtual networking and controlling in automobile industries & eco-emos

REFERENCES:

https://www.edgefx.in/industrial-applications-of-programmable-logic-controller/

www.softbitonline.com/auto_cd5.html

www.durr-india.com/.../120625_Du_PFS_Eco_Paintshop_EN_low.pdf

19UEE867	ENERGY STORAGE SYSTEMS	L	T	P	C
		1	0	0	1

OBJECTIVES

- To impart knowledge on energy storage systems.

UNIT I INTRODUCTION **5**

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT II ELECTRICAL ENERGY STORAGE **10**

Fundamental concept of batteries – measuring of battery performance, charging and discharging of a battery, storage density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide and modern batteries for example (i) zinc-Air (ii) Nickel Hydride, (iii) Lithium Battery.

TOTAL: 15 PERIODS

COURSE OUTCOMES

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

- Analyze electrical energy storage systems

REFERENCES:

1. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, John Wiley & Sons 2002.

2. Fuel cell systems Explained, James Larminie and Andrew Dicks, Wiley publications, 2003.

3. Electrochemical technologies for energy storage and conversion, Ru-shiliu, Leizhang, Xueliang Sun Wiley publications, 2012.

19UEE868	CONTROLLING AND MONITORING OF ELECTRICAL EQUIPMENTS USING MOBILE APPLICATIONS	L	T	P	C
		1	0	0	1

UNIT I MOBILE APPLICATION DEVELOPMENT PLATFORM (OS) / FRAMEWORK 5

Introduction to Mobile Computing – Introduction to Various Mobile Application Development Platforms – J2ME Development Environment –J2ME Architecture – Overview of J2ME SDK Basic Building Blocks – J2ME User Interface Components.

UNIT II DESIGN AND DEVELOPMENT OF MOBILE APPLICATION FOR ELECTRICAL EQUIPMENTS 5

Overview of modern Sensors for measuring electrical parameters voltage, current and frequency in built with ADC - Block Diagram of Micro-Controller – GSM Modem – J2ME User Interface(UI) Design - J2ME Connect to DataBase – Schematic for Voltage, current and Power measurement monitoring Mobile Application – Building simple sample J2ME Application.

UNIT III TESTING AND DEPLOYMENT OF MOBILE APPLICATION FOR ELECTRICAL EQUIPMENTS 5

Various J2ME Emulator Platforms – Different methods of Deployment of J2ME Application – Deployment procedure for simple Power Calculation Mobile Application from Voltage, Current and Powerfactor.

TOTAL: 15 PERIODS

TEXT BOOK

1. J2ME: The complete Reference, James Keogh, Tata McGrawHill.

REFERENCE BOOKS:

1. Enterprise J2ME: Developing Mobile Java Applications – Michael Juntao Yuan, Pearson Education, 2004.
2. Beginning Java ME platform, Ray Rischpater, Apress, 2009.
3. Beginning J2ME: From Novice to Professional, Third Edition, Sing Li, Jonathan B. Knudsen, Apress, 2005.
4. Kicking Butt with MIDP and MSA: Creating Great Mobile Applications, 1st edition, J.Knudsen, Pearson.

19UEE869	ELECTRICAL REWINDING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS:

1. To rewind a single phase Induction motor used for water pump
2. To rewind a single phase Induction motor used for ceiling fan
3. To perform various test in a single phase induction motor after completion of rewinding

TOTAL: 30 PERIODS

MATERIALS RQUIRED:

Manual Rewinding machine

Copper coil

Tools