DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

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

PERAMBALUR - 621212

REGULATIONS – 2020

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicable to the students admitted from the Academic year 2020 – 2021)

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(Applicable to the students admitted from the Academic year 2020 – 2021)

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

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

B.E ELECTRICAL AND ELECTRONICS ENGINEERING

REGULATIONS-2020

CHOICE BASED CREDIT SYSTEM

COURSE MATRIX

SEMESTER-I

SL. NO	SUBJECT CODE	NAME OF THE SUBJECT	CREDIT	L-T-P	INTERNAL ASSESSMENT		END SEMESTER EXAMINATION		MINIMUM PASSING MARKS
					MAX. MARKS	MIN. MARKS	MAX. MARKS	MIN. MARKS	
1	U20HS101	Communicative English	3	3-0-0	20		80		50
2	U20MA101	Engineering Mathematics	4	3-1-0	20		80		50
3	U20PH101	Engineering Physics - I	3	3-0-0	20		80		50
4	U20CY101	Engineering Chemistry	3	3-0-0	20		80		50
5	U20GE101	C -Programming	3	3-0-0	20		80		50
6	U20GE102	Engineering Graphics	4	2-0-4	20		80		50
7	U20BS101	Physics and Chemistry Laboratory	2	0-0-4	20		80		50
8	U20GE103	C - Programming Laboratory	2	0-0-4	20		80		50
Total			**24**	**17-1-12**					

HS	BS	ES	PC	PE	OE	EEC	TOTAL CREDITS
3	**12**	**-**	**-**			**9**	**24**

SEMESTER-II									
SL. NO	SUBJECT CODE	NAME OF THE SUBJECT	CREDIT	L-T-P	INTERNAL ASSESSMENT		END SEMESTER EXAMINATION		MINIMUM PASSING MARKS
					MAX. MARKS	MIN. MARKS	MAX. MARKS	MIN. MARKS	
1	U20HS201	Functional English	3	3-0-0	20		80		50
2	U20MA201	Advanced Calculus and Ordinary Differential Equations	4	3-1-0	20		80		50
3	U20PH201	Engineering Physics - II	3	3-0-0	20		80		50
4	U20GE201	Python Programming	3	3-0-0	20		80		50
5	U20EE201	Circuit Theory	3	3-0-0	20		80		50
6	U20HS202	Environmental Science and Engineering	3	3-0-0	20		80		50
7	U20GE203	Engineering Practices Laboratory	2	0-0-4	20		80		50
8	U20EE202	Electric Circuits Laboratory	2	0-0-4	20		80		50
9	U20GE204	Python Programming Laboratory	2	0-0-4	20		80		50
Total			**25**	**18-1-12**					

HS	BS	ES	PC	PE	OE	EEC	TOTAL CREDITS
3	7	7	8	-	-	-	25

	SEMESTER - III								
Sl. No.	**Subject Code**	**Name of the Subject**	**Credit**	**L–T–P**	**Internal Assessment**		**End Semester Examination**		**Minimum Passing Marks**
					Max Marks	**Min Marks**	**Max Marks**	**Min Marks**	
1	U20MA301	Transforms and Partial Differential Equations	4	3-1-0	20		80		50
2	U20EE301	Electrical Machines-I	3	3-0-0	20		80		50
3	U20EE302	Electromagnetic Field Theory	3	3-0-0	20		80		50
4	U20EE303	Electronic Devices and Circuits	3	3-0-0	20		80		50
5	U20EE304	Network Analysis and Synthesis	4	3-1-0	20		80		50
6	U20EE305	Digital Logic Circuits	3	3-0-0	20		80		50
7	U20EE306	Electronics Laboratory	2	0-0-4	20		80		50
8	U20EE307	Electrical Machines-I Laboratory	2	0-0-4	20		80		50
Total			**24**	**18-2-8**					

PC	**HS**	**BS**	**ES**	**PE**	**OE**	**EEC**	**Total Credits**
15	**--**	**4**	**5**	**--**	**--**	**--**	**24**

SEMESTER –IV

Sl. No	Subject Code	Name of the Subject	Credit	L–T–P	Internal Assessment		End Semester Examination		Minimum Passing Marks
					Max Marks	Min Marks	Max Marks	Min Marks	
1	U20MA405	Statistics and Numerical Methods	4	3-1-0	20		80		50
2	U20EE401	Electrical Machines – II	3	3-0-0	20		80		50
3	U20EC301	Signals and Systems	4	3-1-0	20		80		50
4	U20EE402	Measurements and Instrumentation	3	3-0-0	20		80		50
5	U20EE403	Transmission and Distribution	3	3-0-0	20		80		50
6	U20EE404	Linear Integrated Circuits and Applications	3	3-0-0	20		80		50
7	U20EE405	Electrical Machines Laboratory - II	2	0-0-4	20		80		50
8	U20EE406	Linear and Digital Integrated Circuits Laboratory	2	0-0-4	20		80		50
Total			**24**	**18-2-8**					

PC	HS	BS	ES	PE	OE	EEC	Total Credits
20	**--**	**4**	**--**	**--**	**--**	**--**	**24**

SEMESTER –V									
Sl. No	**Subject Code**	**Name of the Subject**	**Credit**	**L–T–P**	**Internal Assessment**		**End Semester Examination**		**Minimum Passing Marks**
					Max Marks	**Min Marks**	**Max Marks**	**Min Marks**	
1	U20EE501	Power System Analysis	3	3-0-0	20		80		50
2	U20EE502	Control Systems	4	3-1-0	20		80		50
3	U20EE503	Power Electronics	3	3-0-0	20		80		50
4	U20EE504	Internet of Things based System Design	3	3-0-0	20		80		50
5	U20EE505	Microprocessors and Microcontrollers	3	3-0-0	20		80		50
6		Open Elective I	3	3-0-0	20		80		50
7	U20EE506	Control and Instrumentation Laboratory	2	0-0-4	20		80		50
8	U20EE507	Microprocessor and Microcontroller Laboratory	2	0-0-4	20		80		50
Total			**23**	**18-1-8**					

PC	**HS**	**BS**	**ES**	**PE**	**OE**	**EEC**	**Total Credits**
20	**--**	**--**	**--**	**--**	**3**	**--**	**23**

SEMESTER –VI

Sl. No	Subject Code	Name of the Subject	Credit	L–T–P	Internal Assessment		End Semester Examination		Minimum Passing Marks
					Max Marks	Min Marks	Max Marks	Min Marks	
1	U20EE601	Embedded Systems	3	3-0-0	20		80		50
2	U20EE602	Design of Electrical Apparatus	4	3-1-0	20		80		50
3	U20EE603	Power System Operation and Control	3	3-0-0	20		80		50
4	U20EE604	Protection and Switchgear	3	3-0-0	20		80		50
5		Professional Elective I	3	3-0-0	20		80		50
6	U20EE605	Power Electronics and Drives Laboratory	2	0-0-4	20		80		50
7	U20EE606	Power System Simulation Laboratory	2	0-0-4	20		80		50
8	U20HS601	Professional Communication	1	0-0-2	20		80		50
Total			**21**	**18-1-10**					

PC	HS	BS	ES	PE	OE	EEC	Total Credits
17	**--**	**--**	**--**	**3**	**--**	**1**	**21**

Professional Elective - I	
U20EE611	Flexible AC Transmission Systems
U20EE612	Thermal and Fluid Engineering
U20EE613	Modern Control Systems
U20EE614	Micro Electro Mechanical Systems
U20EE615	Special Electrical Machines
U20EE616	FPGA Based Architecture Design
U20EE617	Modern Power Electronic Converters
U20GE635	Intellectual Property Rights

SEMESTER –VII

Sl. No	Subject Code	Name of the Subject	Credit	L–T–P	Internal Assessment		End Semester Examination		Minimum Passing Marks
					Max Marks	Min Marks	Max Marks	Min Marks	
1	U20EE701	Renewable Energy Systems	3	3-0-0	20		80		50
2	U20EE702	Solid State Drives	3	3-0-0	20		80		50
3	U20EE703	Utilization of Electrical Energy	3	3-0-0	20		80		50
4		Open Elective II	3	3-0-0	20		80		50
5		Professional Elective II	3	3-0-0	20		80		50
6	U20EE704	Project Work - Phase-I	2	0-0-4	20		80		50
7	U20EE705	Renewable Energy Systems Lab	2	0-0-4	20		80		50
Total			**19**	**15-0-8**					

PC	HS	BS	ES	PE	OE	EEC	Total Credits
11	**--**	**--**	**--**	**3**	**3**	**2**	**19**

Professional Elective - II	
U20EE721	Virtual Instrumentation
U20EE722	High Voltage Engineering
U20EE723	Control of Electrical Drives
U20EE724	Power Quality and Improvement Techniques
U20EE725	Electrical Safety
U20EE726	Design of Power Supplies
U20GE755	Total Quality Management
U20GE702	Research Methodology

SEMESTER –VIII

Sl. No	Subject Code	Name of the Subject	Credit	L–T–P	Internal Assessment		End Semester Examination		Minimum Passing Marks
					Max Marks	Min Marks	Max Marks	Min Marks	
1		Professional Elective III	3	3-0-0	20		80		50
2		Professional Elective IV	3	3-0-0	20		80		50
3	U20EE801	Project Work - Phase-II	6	0-0-12	20		80		50
Total			**12**	**6-0-12**					

PC	HS	BS	ES	PE	OE	EEC	Total Credits
--	--	--	--	6	--	6	12

Professional Elective - III		Professional Elective - IV	
U20EE831	VLSI Design	U20EE841	HVDC Transmission
U20EE832	Energy Management and Audit	U20EE842	Reactive Power Management
U20EE833	Distributed Generation and Micro grids	U20EE843	Testing and Commissioning of Electrical Equipments
U20EE834	Power Electronics for Renewable Energy Systems	U20EE844	Electric Vehicles Charging Technologies
U20EE835	Electrical and Hybrid Vehicles	U20EE845	Electrical Wiring Estimation and Costing
U20EE836	Energy Storage System	U20EE846	Applied Soft Computing
U20EE837	Power system Restructuring and Pricing	U20EE847	Diagnosis and Protection for Solid State Systems
U20GE801	Professional Ethics in Engineering	U20EE848	Bio Medical Instrumentation

TOTAL COURSES & CREDITS-SEMESTER WISE

Semester	I	II	III	IV	V	VI	VII	VIII	TOTAL
No of Courses	8	9	8	8	8	8	7	3	59
Credits	24	25	24	24	23	21	19	12	172

SUMMARY

B. E., Electrical and Electronics Engineering											
S. No	Subject Area	Credits per Semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities Sciences and social sciences	3	6	0	0	0	0	0	0	9	5.26
2	Basic Sciences	12	7	4	4	0	0	0	0	27	15.79
3	Engineering Sciences	9	7	5	0	0	0	0	0	21	12.28
4	Professional Core	0	5	15	20	20	17	11	0	88	51.46
5	Professional Electives	0	0	0	0	0	3	3	6	12	7.02
6	Open Electives	0	0	0	0	3	0	3	0	6	3.51
7	Employability Enhancement Courses	0	0	0	0	0	1	2	6	9	5.26
Total		**24**	**25**	**24**	**24**	**23**	**21**	**19**	**12**	**172**	**100**

SEMESTER I

U20HS101	COMMUNICATIVE ENGLISH (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Pre-requisite: Acquiring Basic grammar knowledge.

COURSE OBJECTIVES

- To enable the engineering students to develop their basic communication skills in English for academic and social purposes.
- To equip the students with appropriate oral and written communication skills.
- To inculcate the skills of listening, reading and critical thinking.
- To integrate English Language learning with employability skills and training.
- To enhance the students' proficiency in reading skills enabling them meet the academic demands of their course.

UNIT I GENERAL INTRODUCTION **9**

Listening - Listening to conversations, Welcome Speeches, Lectures and description of equipment. Speaking - introducing one self - family and friends. Reading - Practice in skimming - scanning and predicting - Writing - completing sentences. Grammar - WH - Questions - asking and answering - Yes or No questions and Question Tag - Parts of Speech. Prefixes - Suffixes - Tense- Present, Past and Future Tense. Word formation.

UNIT II TECHNIQUES OF READING AND WRITING **9**

Reading - Purpose of reading-comprehension - re - reading- post reading - comprehension questions (multiple choice questions or short questions/open-ended questions). Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Autobiographical writing (writing about one's leisure time activities, hometown, etc.) - Listening - Situational Conversation, Telephonic Conversation. Speaking - Sharing information of a personal kind - greeting - Taking leave - Grammar - Adjectives, Prepositions, Conjunctions, Articles, Punctuations - Error correction, editing mistakes in grammar, vocabulary, spelling.

UNIT III GRAMMAR AND SKILL DEVELOPMENT **9**

Reading - Reading general contexts and interpreting graphical representations. Writing - understanding text structure - Use of reference words and discourse markers - Coherence - Jumbled Sentences Listening - listening to longer texts and filling up the table - Product description - narratives from different sources. Speaking - asking about routine actions and expressing opinions. Grammar-Past Tense - Kinds of noun, verb and adverb, Impersonal Passive voice.

UNIT IV READING AND LANGUAGE DEVELOPMENT **9**

Reading - Short reading passages for sentence matching exercises, Picking out specific information in a short text. Writing - Letter writing, informal or personal letters - e-mails - conventions of personal e-mail - Listening-listening to dialogues or conversations and completing exercises based on them. Speaking - Group Discussion - Grammar - Future tense, Synonyms - Antonyms - Phrasal verbs.

UNIT V WRITING SKILLS **9**

Reading - Intensive reading - Writing - Writing short essays - Dialogue Writing - Listening - listening to talks - conversations - Speaking - Presenting welcome speech and vote of thank - Grammar - Modal verbs - Collocations - Single word substitutes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Speak clearly, effortlessly, confidently and appropriately.
2. Write coherently with acceptable accuracy, organizing ideas logically.
3. Listen and comprehend different discourses and genres of texts.
4. Read and comprehend different discourses and genres of texts.
5. Read and infer, analyze, predict, interpret and draw conclusions any printed text.

TEXT BOOKS

1. Board of Editors Using English "A Course book for Undergraduate Engineers and Technologists". Orient Black Swan Limited, Hyderabad, 2015.
2. Richards, C. Jack. "Interchange Students'Book-2", New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. "Academic Writing: A practical guide for students". New York: Rutledge, 2011.
2. Raymond Murphy, Murphy's "English Grammar", Cambridge University Press 2004.
3. Meenakshi Raman, Sangeeta Sharma, "Technical Communication: English Skills for Engineers", Oxford University Press, 2009.
4. Dr.S.Sumant, "Technical English-I" Tata McGraw-Hill, New Delhi, 2001.
5. Essential English - E.Suresh Kumar, P. Sreehari, J. Savithri - Orient Blackswan 2011.

U20MA101	ENGINEERING MATHEMATICS (COMMON TO ALL BRANCHES)	L	T	P	C
		3	1	0	4

Prerequisite: Basic ideas of Matrices, Differentiation and Integration.

COURSE OBJECTIVES

- To handle practical problems arising in the field of engineering.
- To achieve conceptual understanding and to retain the best traditions of traditional calculus.
- To provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- To deal with topics such as single variable and multivariable Calculus.
- To play an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I EVALUATION AND APPLICATION OF MATRICES 12

Definition - Basic concepts of Matrices - Eigen values and Eigen vectors of a real matrix -Characteristic equation -Properties of Eigen values and Eigen vectors - Cayley - Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by Orthogonal transformation - Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of a function - Continuity - Derivatives - Differentiation Rules - Mean Value Theorem - Interval of increasing and decreasing functions - Maxima and Minima - Interval of concavity and convexity.

UNIT III MULTIVARIABLE CALCULUS 12

Limits and Continuity - Partial derivatives - Total derivative - Differentiation of implicit functions - Jacobian and properties -Taylor's series for functions of two variables -Maxima, Minima and saddle points - Method of Lagrange multipliers.

UNIT IV INTEGRAL CALCULUS 12

Definite Integrals and its properties - Fundamental theorem of Calculus - Techniques of integration for Indefinite Integrals using basic integration formulas -Integration by parts -Trigonometric Substitutions - Integration of Rational functions by Partial Fractions.

UNIT V MULTIPLE INTEGRAL AND THEIR APPLICATIONS 12

Double integrals - Change the order of integration - Polar Coordinates - Area - Change of variables - Triple integrals - Volume - Applications - Areas and Volumes.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Express large amounts of data and functions in an organized and concise form apart from diagonalizing matrices.
2. Solve maxima and minima problems using differentiation.
3. Apply functions of several variables to solve problems in engineering and technology.
4. Evaluate integrals by using Fundamental Theorem of Calculus.
5. Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change the order and change of variables.

TEXT BOOKS

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Ed., 2014.
2. Veerarajan T, “Engineering Mathematics”, Tata McGraw-Hill, New Delhi, 2011.

REFERENCES

1. Bali N. P. and Manish Goyal, “Engineering Mathematics” (For Semester I) Third Edition, University Science Press, 2017.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons,2014
3. Fritz John and Richard Courant, “Introduction to Calculus and Analysis” Springer, 1999.
4. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi, 2015.
5. Venkatraman M K, “Engineering Mathematics, Volume-I”, Second edition, National Publishing Co, Chennai, 2003.

U20PH101	ENGINEERING PHYSICS - I (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Pre-requisite: Adequate knowledge in basic and modern physics.

COURSE OBJECTIVES

- To import knowledge in basic concepts of physics relevant to engineering applications.
- Capability to understand advanced topics in engineering.
- To acquire the knowledge of recent trends in LASER, Optical Fiber, and Ultrasonic.

UNIT I SOLID STATE PHYSICS 9

Lattice -unit cell -seven crystal systems -Bravai’s lattices -lattice planes -Miller indices –derivation for inter-planar spacing in terms of Miller indices-calculation of number of atoms per unit cell , atomic radius , coordination number and packing factor for SC, BCC, FCC and HCP structures. X-ray diffraction: Bragg’s law -diffraction methods: powder and Laue methods. Crystal Growth Techniques: melt growth technique (Bridgman and Czochralski techniques).

UNIT II ELASTICITY OF MATTER 9

Introduction- Elasticity - Plasticity–Hooke's law - relationship between three modulii of elasticity (qualitative) -stress –strain diagram -Poisson's ratio - factors affecting elasticity. Beam: Internal Bending moment -Cantilever: theory and experiment-Young's modulus: theory and experiment (uniform and non-uniform bending) -I-shaped girders-advantages and applications -twisting couple of a wire or cylinder - torsion pendulum - determination of moment of inertia of disc and rigidity modulus of cylindrical wire.

UNIT III ULTRASONICS AND ITS APPLICATIONS 9

Introduction-classification of sound- properties of infrasonics, audible and ultrasonics -production: magnetostriction and piezoelectric methods–detection of ultrasonic waves–determination of velocity of sound in liquid (Acoustic grating method). Applications: Engineering and medical field- Non-destructive testing: pulse echo system through transmission and reflection modes. Ultrasonic scanning methods-Sonogram.

UNIT IV MODERN PHYSICS 9

Black body radiation- Basic Laws -Planck's hypothesis and its radiation law: derivation -deduction of Wien's displacement law and Rayleigh Jean's law from Planck's law -Photons and its properties-Compton Effect –derivation –experimental verification. Photo Electric effect and its Laws -Einstein's Equation - Matter waves–de-Broglie hypothesis - de-Broglie wavelength-Schrodinger's time independent and time dependent wave equations -physical significance of the wave function. Application: particle in one dimensional box-normalization - degenerate and non-degenerate states.

UNIT V LASER AND OPTICAL FIBER 9

Laser: properties–population inversion-pumping methods –Einstein's coefficients-derivation. Types: He-Ne and semiconductor lasers (Homo and Hetero junction) –uses of LASER- Hologram -Construction and Reconstruction Process. Optical fiber: Structure-advantages of optical fibre-Principle and propagation of light through optical fiber–expressions for numerical aperture and acceptance angle–fabrication of optical fiber- types of optical fibers-fiber optical communication system -endoscope -Fiber optic sensors (Qualitative Study only).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Assess the elastic behavior of the materials and bending behavior of beam.
2. Acquire knowledge of NDT and applications of ultrasonics.
3. Know the development of modern physics and its applications.
4. Recognize the uses of laser and fiber optics.
5. Distinguish the different crystal systems, structural determination and synthesis of crystals.

TEXT BOOKS

1. Marikani, "Engineering Physics", PHI, New Delhi, 2013.
2. S. Vadivel & A. Pannerselvam, "Engineering Physics", Jaitech Publications, 2015.

REFERENCES

1. Selladurai, "Engineering Physics Part-I", PHI learning private limited, New Delhi, 2010.
2. V.Rajendran, "Engineering Physics", Tata McGraw-Hill. New Delhi.2011
3. P. K. Palanisamy "Engineering Physics". Scitech Publications, 2011
4. Raymond A. Serway and John Jewett, Jr. , "Physics for Scientist and Engineer with modern Physics", Mary Finch Publication, 9th edition,2014.
5. William T. Silfvast ,"Laser Fundamentals", Second Edition, Cambridge University Press, 2008.

U20CY101	ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Pre-requisite: Basics of Ionisation, adsorption phenomenon kinetics, Light emission components

COURSE OBJECTIVES

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photo physical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two Component systems and appreciate the purpose and significance of alloys.

UNIT I BASICS OF POLYMER 9

Introduction: Classification of Polymers -Natural and Synthetic: Thermoplastic and Thermosetting Functionality -Degree of Polymerization. Types and mechanism of Polymerization: Addition, Condensation and Co-polymerization. Properties of Polymer - Techniques of Polymerization: Bulk, Emulsion, Solution and Suspension. Preparation, Properties and uses of Nylon6.6, and Epoxy resin.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of Adsorption -Adsorption of gases on solids -Adsorption of solute from solutions - Adsorption isotherms -Freundlich's Adsorption Isotherm -Langmuir's Adsorption Isotherm -Applications of Adsorption on pollution abatement. Catalysis: Catalyst -Types of Catalysis -Criteria -Auto Catalysis - Catalytic Poisoning and Catalytic Promoters - Acid Base Catalysis -Enzyme Catalysis - Michaelis - Menten equation.

UNIT III CHEMICAL THERMODYNAMICS 9

Terminology of Thermodynamics - Second Law: Entropy - Entropy change for an ideal gas, Reversible and Irreversible Processes; Entropy of Phase Transitions; Clausius inequality. Free Energy and Work function: Helmholtz and Gibbs free energy functions - Criteria of Spontaneity: Gibbs - Helmholtz equation -Clausius - Clapeyron equation: Maxwell Relations - Van't Hoff Isotherm and Isochore.

UNIT IV PHOTO CHEMISTRY AND SPECTROSCOPY 9

Photo Chemistry: Laws of Photo Chemistry - Grotthuss-Draper law, Stark - Einstein Law and Lambert - Beer Law. Quantum Efficiency - Determination - Photo Processes - Internal Conversion, Inter - system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic Spectrum- Absorption of Radiation - Electronic, Vibrational and Rotational transitions. UV - visible and IR Spectroscopy.

UNIT V PHASE RULE AND ALLOYS 9

Phase Rule: Introduction, Definition of terms with examples, One Component System - Water System - Reduced Phase Rule - Two Component Systems - Classification - Lead - Silver system, Zinc - Magnesium system. Alloys: Introduction - Definition- Properties of Alloys - Significance of Alloying, Functions and Effect of Alloying elements- Ferrous Alloys- Nichrome and Stainless Steel - Heat Treatment of Steel.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Describe the General Structure of Polymers. Identify and Explain differences between Addition and Stepwise Polymerization.
2. Explain how selected Isomers could be used for measurement of Surface Area of Materials or in Rationalization of Catalysis.
3. Derive and discuss the First and Second Laws of Thermodynamics.
4. Making possible to apply this knowledge in different areas, other than Photo Chemistry and Spectroscopy.
5. Illustrate the Phase Transition of One Component and Two Component system and Types of Alloys and their applications in industries.

TEXT BOOKS

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi- tech Publishing Company Pvt. Ltd. Chennai, 2009.

REFERENCES

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V. R. , Viswanathan N.V. and Jayadev Sreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006.
4. Shashi Chawla, "A Text Book of Engineering Chemistry", Dhanapat Rai & Co. (P) Ltd, Delhi, 2013.
5. Satya Prakash and Manish Agarwal, "Engineering Chemistry", Khanna Book Publishing Co.(P) Ltd, Delhi,2018.

U20GE101	C - PROGRAMMING (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Computer knowledge to access a computer

COURSE OBJECTIVES

- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions , pointers and structures
- To do input/output and file handling in C.

UNIT I BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms - Structure of C program - C programming: Data Types - Storage classes - Constants - Keywords - Operators: Precedence and Associativity - Expressions - Input/ Output statements, Assignment statements - Decision making statements - Switch statement - Looping statements - Pre-processor directives - Compilation process

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization - One dimensional array - Example Program: Computing Mean, Median and Mode - Two dimensional arrays - String operations: length, compare, concatenate, copy - Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS 9

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) - Recursion - Example Program: Scientific calculator using built-in functions, Binary Search using recursive functions - Pointers - Pointer operators - Pointer arithmetic - Arrays and pointers - Array of pointers.

UNIT IV STRUCTURES 9

Structure - Nested structures - Pointer and Structures - Array of structures - Example Program using structures and pointers - Union- Example Program using unions and pointers.

UNIT V FILE PROCESSING 9

Files - Types of file processing: Sequential access, Random access - Sequential access file - Example Program: Finding average of numbers stored in sequential access file - Random access file - Example Program: Transaction processing using random access files - Command line arguments.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Develop simple applications in C using basic constructs
2. Design and implement applications using arrays and strings
3. Develop and implement applications in C using functions and pointers.
4. Develop applications in C using structures.
5. Design applications using sequential and random access file processing

TEXT BOOKS

1. Reema Thareja, ”Programming in C”, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie, D.M, “The C Programming language”, Second Edition, Pearson Education, 2006.

REFERENCES

1. Paul Deitel and Harvey Deitel, —”C How to Program”, Seventh edition, Pearson Publication.
2. Juneja, B. L and Anita Seth, “Programming in C”, CENGAGE Learning India pvt. Ltd., 2011.
3. Pradip Dey, Manas Ghosh, “Fundamentals of Computing and Programming in C”, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

U20GE102	ENGINEERING GRAPHICS (COMMON TO ALL BRANCHES)	L	T	P	C
		2	0	4	4

Pre-requisite: Basic knowledge in practical geometry construction, imagination and mathematics.

COURSE OBJECTIVES

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

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 6+12

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimension. Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method (polygonal and circular surfaces) inclined to both the planes.

UNIT III PROJECTION OF SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple solids - Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC PROJECTION 6+12

Principles of Isometric Projection - Isometric scale –Isometric projections of simple solids and truncated solids - Prisms, Pyramids, Cylinders, Cones- combination of two solid objects in simple vertical positions.

TOTAL: 30+60 = 90 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Familiarize with the fundamentals and standards of Engineering graphics.
2. Perform freehand sketching of basic geometrical constructions and multiple views of objects.
3. Project orthographic projections of lines and plane surfaces.
4. Draw projections and solids and development of surfaces.
5. Visualize and to project isometric and perspective sections of simple solids.

TEXT BOOKS

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

REFERENCES

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
5. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

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

Special points applicable to Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

U20BS101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2

Pre-requisite: Basic knowledge of Physics and chemistry laboratory apparatus.

PHYSICS LABORATORY

COURSE OBJECTIVE

- To handle different experiments to test the physics concepts applied in optics, thermal physics, electronics, sound, elasticity and etc.

LIST OF EXPERIMENTS

1. Find the Young’s modulus by non-uniform bending method
2. Verify of band gap energy of a PN junction semiconductor using PN junction kit
3. Determination of wavelength of Laser and particle size using Laser grating method
4. Determination of rigidity modulus of given wire using Torsion pendulum method
5. Determination of thickness of a thin specimen using Air wedge method

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS:

Young’s Modulus: Non-Uniform bending

a. Travelling Microscope - 6 Nos.
b. Pin -Scale Knife edge - 6 Nos.

Band gap

a. PN Junction diode setup - 6 Nos.
b. Eliminator - 6 Nos.

Particle Size

a. Laser grating - 6 Nos.
b. Circular disc with particle coated - 6 Nos.
c. Laser Source - 6 Nos.

Torsional Pendulum

a. Torsional Pendulum - 6 Nos.
b. Thin wire - 6 Nos.
c. Cloch - 6 Nos.
d. Screw gauge - 6 Nos.

Air wedge

a. Air wedge - 6 Nos.
b. Travelling Microscope - 6 Nos.
c. Mercury vapour lamp - 6 Nos.

TOTAL :30 PERIODS

COURSE OUTCOMES:

Learners are able to

. Apply the basic theory for the corresponding experiment
. Know the procedure to use physics equipment

CHEMISTRY LABORATORY

COURSE OBJECTIVES

- To make the student to acquire practical skills in the determination of water quality
- Parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by Viscometery.

LIST OF EXPERIMENTS

1. Determination of DO content of water sample by Winkler's method.
2. Determination of chloride content of water sample by argentometric method.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of HCL using conductivity meter
5. Determination of molecular weight of polyvinyl alcohol using Ostwald visco meter.

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS:

a. Iodine flask - 30 Nos.
b. PH meter - 5 Nos.
c. Conductivity meter - 5Nos.
d. Spectrophotometer - 5 Nos.
e. Ostwald Viscometer - 10 Nos.
f. Common Apparatus: Pipette, Burette, Conical Flask, Porcelain tile, Dropper

TOTAL :30 PERIODS

COURSE OUTCOMES :

Learners are able to

1. The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.
2. Utilize the fundamental laboratory techniques for analyses such as titrations, separation, purification and spectroscopy.

		L	T	P	C
U20GE103	**C - PROGRAMMING LABORATORY (COMMON TO ALL BRANCHES)**	**0**	**0**	**4**	**2**

Pre-requisite: Basic computer knowledge to install software.

COURSE OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

LIST OF EXPERIMENTS

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Populate an array with height of persons and find how many persons are above the average height.
7. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
8. Given a string “a$bcd./fg “find its reverse without changing the position of special characters.(Example input: a@gh%;j and output: j@hg%;a)
9. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
10. From a given paragraph perform the following using built-in functions:
    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
11. Solve towers of Hanoi using recursion.
12. Sort the list of numbers using pass by reference.
13. Generate salary slip of employees using structures and pointers.
14. Compute internal marks of students for five different subjects using structures and functions.
15. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.

TOTAL: 60 PERIODS

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS:

HARDWARE:

1.Standalone desktops - 30 Nos.

SOFTWARE:

1. C / Equivalent Compiler - 30 Nos.

COURSE OUTCOMES:

Learners are able to

1. Develop C programs for simple applications making use of basic constructs, arrays and strings.
2. Develop C programs involving functions, recursion, pointers, and structures.
3. Design applications using sequential and random access file processing.

SEMESTER II

U20HS201	**FUNCTIONAL ENGLISH (COMMON TO ALL BRANCHES)**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Pre-requisite: Basics skills development of Reading and Writing.

COURSE OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I VOCABULARY AND GRAMMAR 9

Listening - Listening to talks mostly of a scientific/technical .Speaking - Asking for and giving directions- Reading - reading short technical texts from journals-newspapers- Writing- purpose statements– extended definitions- issue-writing instructions - recommendations- Language Development–subject verb agreement -compound words. Technical vocabulary.

UNIT II TECHNIQUES OF READING AND WRITING 9

Listening: Listening Process; Types of Listening; Intensive vs. Extensive Listening; Barriers to Listening. Speaking - describing a process-Reading - reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting charts, graphs- Language Development - vocabulary used informal letters/emails and reports .Homonyms and Homophones-Common Errors. Numerical adjectives.

UNIT III GRAMMAR AND SKILL DEVELOPMENT 9

Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking –introduction to technical presentations- Reading–longer texts both general and technical, practice in speed reading; Writing- checklists- Describing a process, use of sequence words-Language Development -sequence words- Misspelled words.-use of clauses. Verb forms. Direct/Indirect Speech.

UNIT IV INTERVIEW SKILL AND LANGUAGE DEVELOPMENT 9

Listening- Listening to documentaries and making notes. Speaking - mechanics of presentations- Reading- Reading for detailed comprehension-Writing-email etiquette -job application–cover letter- Résumé preparation (via email and hard copy)- analytical essays and issue based essays-- Language Development -finding suitable synonyms-paraphrasing-. -if conditionals.

UNIT V TECHNICAL WRITING 9

Listening- TED/Ink talks; Speaking–participating in a group discussion - Reading- reading and understanding technical articles Writing- Writing reports- minutes of a meeting- accident and survey- Language Development- Comparative Adjectives

TOTAL: 45 PERIODS

COURSE OUTCOMES

Learners are able to:

1. Use academic and technical vocabulary in relevant contexts. Construct meaningful and grammatically correct sentence.
2. Effectively listen and acquire language and content, read fast and understand texts.
3. Use oral presentation skills in all professional contexts.
4. Demonstrate the understanding of the nature and importance of technical communication Draft various types of technical and business documents like, reports, proposals and business letters.
5. Compose documents like job application, book review etc.

TEXT BOOKS

1. Board of editors. Fluency Using English" A Course book for Undergraduate Engineering Technologists". Orient Blackswan, Hyderabad, 2015.
2. Sudharshana. N.P and Saveetha.C. "English for Technical Communication". Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Barrass, Robert. "Scientists Must Write". London: Routledge.2003.
2. Faculty of English. "Technical Communication". SASTRA Publication. 2017.
3. Raman, Meenakshi & Sangeeta Sharma. "Technical Communication: Wren & Martin. High School English Grammar and Composition". (Revised edn.) New Delhi: Chand & Co. 1995.
4. Dr.S.Sumant, "Technical English" Tata McGraw-Hill, New Delhi, 2001.
5. Essential English - E.Suresh Kumar, P. Sreehari, J. Savithri - Orient Blackswan 2011.

		L	T	P	C
U20MA201	**ADVANCED CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS (COMMON TO ALL BRANCHES)**	**3**	**1**	**0**	**4**

Prerequisite: Basic concepts of vectors and complex numbers.

COURSE OBJECTIVES

- To familiarize the prospective engineers with techniques in ordinary differential equations, complex variables and complex integration.
- The Study of Laplace transforms help to solve the differential equations that occur in various branches of engineering disciplines.
- Vector calculus can be widely used for modeling the various laws of physics.
- The various methods of complex analysis can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I APPLICATIONS OF ORDINARY DIFFERENTIAL EQUATIONS 12

Basic concepts - Separable differential equations - Exact differential equations - Integrating factors - Linear differential equations - Second order linear differential equations with constant coefficients - Particular Integral using operator method and Method of variation of parameters - Homogenous equation of Euler's and Legendre's type-Physical Applications-Oscillations of a Spring.

UNIT II LAPLACE TRANSFORMS 12

Existence conditions - Transforms of elementary functions –Transform of unit step function and unit impulse function - Basic properties - Shifting theorems -Transforms of derivatives and integrals - Transform of periodic functions - Inverse transforms: Convolution theorem (Statement only) and Partial Fractions - Application to solution of linear second order ordinary differential equations with constant coefficients-Unit Step Function-Unit impulse function.

UNIT III VECTOR CALCULUS AND APPLICATIONS 12

Gradient and directional derivative - Divergence and curl - Irrotational and Solenoidal vector fields - Line integral - Surface integral - Area of a curved surface - Green's, Gauss divergence and Stokes' theorems in evaluating line, surface and volume integrals (Planar, Cylindrical and Spherical Surfaces).

UNIT IV ANALYTIC FUNCTIONS 12

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian form - Properties - Harmonic conjugates - Construction of analytic function - Conformal mapping - Mapping by function- Bilinear Transformation.

UNIT V CALCULUS OF COMPLEX FUNCTIONS 12

Complex integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour (No poles on the real axis).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Evaluate the effective mathematical tools to obtain the solutions of first and second order differential equations that model physical processes.
2. Express Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
3. Apply the tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.
4. Express Analytic functions, conformal mapping and complex integration.
5. Solve Laplace transform and inverse transform of simple functions, properties, various related theorems and application to solve the differential equations with constant coefficients.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Veerarajan T., "Engineering Mathematics for first year", Tata McGraw-Hill, New Delhi.

REFERENCES

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, John Wiley & Sons, 2014.
2. N. P. Bali and Manish Goyal "Engineering Mathematics" (For Semester II) Third Edition, University Science Press.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015.
5. Venkatraman M K, "Engineering Mathematics", Volume 1,Second edition, National Publishing Co,Chennai,2003.

U20PH201	ENGINEERING PHYSICS - II (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in material property and its uses.

COURSE OBJECTIVES

- To understand the basics of electric, thermal, magnetic, super conducting and di electric properties of materials
- To aware about recent trends in physics

UNIT I ELECTRON THEORY OF SOLIDS 9

Introduction: types of materials- classical free electron theory: postulates- derivation of electrical conductivity and thermal conductivity- derivation. Wiedemann-Franz law and its verification-merits and demerits of classical free electron theory. Quantum free electron theory: Fermi energy level and its importance -Fermi-Dirac distribution function and its variation with temperature - density of energy states –carrier concentration in metals -average energy of electrons at 0 K.

UNIT II FUNDAMENTALS OF SEMICONDUCTORS 9

Introduction: properties- Types semiconductors- concept of effective mass of an electron and hole. Intrinsic semiconductor: carrier concentration in an intrinsic semiconductor-derivation –variation of Fermi energy level with temperature - Extrinsic semiconductor: carrier concentration derivation (P and N type semiconductor) - Hall effect–theory and experimental determination of Hall coefficient - Applications.

UNIT III DIELECTRICS AND FERRO ELECTRICS 9

Introduction: fundamental definitions in dielectrics–expressions for electronic and ionic polarization mechanisms- orientation polarization - space charge polarization - Langevin - Debye equation - frequency and temperature effects on polarization. Capacitor-energy stored in capacitor- Internal field - Clausius Mossotti relation-dielectric loss –dielectric breakdown - various breakdown mechanisms with characteristics - applications of dielectric materials - Ferro electrics -properties and applications.

UNIT IV MAGNETISM AND SUPER CONDUCTORS 9

Magnetic Materials: Introduction-basic definitions - origin of magnetic moment –Bohr magneton - magnetic materials: classification of dia, para, ferro magnetic materials. Ferro magnetic domains-energies involved in the growth of magnetic domains-hysteresis-explanation of hysteresis curve based on domain theory-soft and hard magnetic materials. Superconducting Materials: properties - types - BCS theory of super conductivity-Applications: cryotron and Mag-lev.

UNIT V NANOMATERIALS 9

Definition of nano system- Quantum confinement - 0D to 3D Quantum confined nanostructures - density of energy states from 3D to 0D- Preparation: top down and bottom up approaches- PLD - PVD - CVD - Electro deposition- Carbon nanotubes-types - SWCNT and MWCNT, Armchair, Zig-zag and Chiral structures-properties-applications

TOTAL: 45 PERIODS

COURSE OUTCOMES :

Learners are able to

1. Select the metals required for specific applications in the area of engineering and technology.
2. Distinguish between different types of semiconductor and determination of Hall co-efficient.
3. Understand the property of dielectric and ferro electric property of materials.
4. Identify different magnetic materials and super conducting materials.
5. Understand the idea used in new technologies

TEXT BOOKS

1. V.Rajendran, “Materials Science”, Tata McGraw- Hill, New Delhi, 2011.
2. S. Vadivel, A. Pannerselvam, “Solid State Physics”, Jaitech Publications, 2015 (Revised edition).

REFERENCES

1. Charles Kittel, “Introduction to Solid State Physics”, John Wiley & sons, 7th edition, Singapore (2007).
2. M. Arumugam, “Materials Science”. Anuradha publishers, 2010.
3. Dr. W. R. Fahrner, "Nanotechnology and Nanoelectronics Materials”, Devices, Measurement Techniques", Springer, 2005
4. J M D. Coey, “Magnetism and Magnetic Materials”, Combridge University Press, 1st edition, 2009.
5. V. Pokropivny, R. Lohmus, I. Hussainova, A. Pokropivny, S. Vlassov. Introduction in nanomaterials and nanotechnology. - University of Tartu. - 2007.

U20GE201	PYTHON PROGRAMMING (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

Pre-requisite: Basic Knowledge of concepts like variables, loops and control statement

COURSE OBJECTIVES

- To acquire programming skills in core Python.
- To develop Python programs with conditionals and loops.
- To develop the skill of designing Graphical user Interfaces in Python
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS AND STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW AND FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES AND DICTIONARIES 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; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT V FILES, MODULES AND PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

Learners are able to

1. Develop algorithmic solutions to simple computational problems
2. Decompose a Python program into functions.
3. Implement database and GUI applications
4. Represent compound data using Python lists, tuples, dictionaries.
5. Read and write data from/to files in Python Programs.

TEXT BOOKS

1. Allen B. Downey,"Think Python: How to Think Like a Computer Scientist‟", 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python ", Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

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. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving 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.

		L	T	P	C
U20EE201	**CIRCUIT THEORY**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge of AC and DC circuits

COURSE OBJECTIVES

- To introduce Electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To analyze the three phase circuits and basic concepts two port networks.
-

UNIT I BASIC CIRCUITS ANALYSIS 9

Ohm's Law - Kirchoff's laws - - Mesh current and node voltage method of analysis for DC and AC circuits - Network reduction: voltage and current division, source transformation - star delta conversion.

UNIT II NETWORK THEOREMS 9

Network Theorems - Thevenin's and Norton Theorems - Superposition Theorem - Maximum power transfer Theorem - Reciprocity Theorem- Millman's Theorem - Power Division Theorem - Applications of network theorems.

UNIT III RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance - their frequency response - Quality factor and Bandwidth - Self and mutual inductance–Coefficient of coupling - Tuned circuits - Single tuned and double tuned circuits.

UNIT IV TRANSIENT RESPONSE OF DC AND AC CIRCUITS 9

Natural response - Forced response - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input - Time constant.

UNIT V THREE PHASE CIRCUITS AND TWO PORT NETWORKS 9

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & Un-balanced – power and power factor measurement in three phase circuits - Two port networks - π and T networks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Analyse electrical circuits
2. Apply circuit theorems
3. Analyse transients
4. Analyse two port networks

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”, McGraw Hill publishers, edition, New Delhi, 2013.
2. Chakrabarti A, “Circuit Theory (Analysis and synthesis), Dhanpat Rai & Sons, New Delhi, 1999.

REFERENCES

1. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
2. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw-Hill, New Delhi, 2010.
3. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
4. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.
5. Dr.P.S.Kannan, “Establishment of Power Division Theorem”, International Journal of Engineering Science and Computing, Volume - 8, Issue - 10.

U20HS202 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Engineering chemistry and ecosystem

COURSE OBJECTIVES

- To the study of nature and the facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth’s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ECO SYSTEMS AND BIODIVERSITY 9

Definition – concept of an ecosystem– structure and function of an ecosystem - Oxygen cycle and Nitrogen cycle –energy flow in the ecosystem – ecological succession- structure and function of the (a) forest ecosystem (b) grass and ecosystem (c) desert ecosystem (d) aquatic ecosystems. Introduction- definition, classification of India–value of biodiversity-India as a mega-diversity nation –hot-spots of biodiversity– threats to biodiversity endangered and endemic species of India–conservation of biodiversity.

UNIT II ENVIRONMENTAL POLLUTION 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 (g) Nuclear hazards – Solid waste management- disaster management: floods, earthquake, cyclone and landslides.

UNIT III NATURAL RESOURCES 9

Forest resources – deforestation - Water resources - dams - benefits and problems – Mineral resources - mineral resources – Food resources – Energy resources, Land resources – Role of an individual in conservation of natural resources.

UNIT IV GREEN CHEMISTRY 9

Introduction, Principles, Toxicity - Green chemistry in Plastics, Energy, sustainable development – Controlled environmental agriculture Avoidance of toxic fictional group - reduce the toxic chemicals - Advantage and disadvantages of protected cultivation- Green chemistry using the bio catalytic reactions - Fermentation and Bio transformations. Eco mark, Eco symbol, Green label.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9

Human health Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment From unsustainable to sustainable development – water conservation, rain water harvesting, water shed management – resettlement and rehabilitation - Population growth, variation among nations – population explosion –family welfare programme human rights, consumerism - value education – HIV/AIDS –women and child welfare.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Environmental Pollution or problems cannot be solved by mere laws.
2. Public participation is an important aspect which serves the environmental Protection.
3. Public awareness of environmental is at infant stage.
4. Ignorance and incomplete knowledge has lead to misconceptions
5. Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, 2nd edition, Pearson Education (2004).
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, (2006).

REFERENCES

1. R.K.Trivedi, “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H.Gorhani, “Environmental Encyclopedia”, Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, “Environmental law”, Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan ,R, ”Environmental Studies-From Crisis to Cure”, Oxford University Press (2005).
5. Kaushik, A & Kaushik, CP, “Environmental Science and engineering”, 3rd Edition, New Age International (P) Limited, New Delhi, 2009. (Module I)

U20GE203	ENGINEERING PRACTICES LABORATORY (COMMON TO ALL BRANCHES)	L	T	P	C
		0	0	4	2

Prerequisite: Basic knowledge of Civil, Mechanical, Electrical and Electronics Engineering Equipments

COURSE OBJECTIVE

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

CIVIL ENGINEERING PRACTICES

Buildings:

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

Plumbing Works:

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

b) Study of pipe connections requirements for pumps and turbines.

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

d) Hands-on-exercise:

Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.

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

Carpentry using Power Tools only:

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

b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting

MECHANICAL ENGINEERING PRACTICES

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending:

b) Model making - Trays and funnels.

c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump

b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending.

Example –Exercise - Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

ELECTRICAL ENGINEERING PRACTICES

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

ELECTRONICS ENGINEERING PRACTICES

1. Study of Electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

CIVIL

Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.

1. Carpentry vice (fitted to work bench	15 sets.
2. Standard woodworking tools	15 Nos.
3. Models of industrial trusses, door joints, furniture joints	15 sets.
Power Tools:	5 each
(a) Rotary Hammer	2 Nos.
(b) Demolition Hammer	2 Nos.
(c) Circular Saw	2 Nos.
(d) Planer	2 Nos.
(e) Hand Drilling Machine	2 Nos.
(f) Jigsaw	2 Nos.

MECHANICAL

Arc welding transformer with cables and holders	5 Nos.
1. Welding booth with exhaust facility	5 Nos.
2. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
3. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
4. Centre lathe	2 Nos.
5. Hearth furnace, anvil and smithy tools	2 Sets.
6. Moldings table, foundry tools	2 Sets.

7.	Power Tool: Angle Grinder	2 Nos.
8.	Study-purpose items: centrifugal pump, air-conditioner	One each

ELECTRICAL

1.	Assorted electrical components for house wiring	15 Sets
2.	Electrical measuring instruments	10 Sets
3.	Study purpose items: Iron box, fan and regulator, emergency lamp	1 each 1 No.
4.	Megger (250V/500V)	2 Nos.
5.	Power Tools:	2 Nos.
	a) Range Finder	2 Nos.
	b) Digital Live-wire detector	2 Nos.

ELECTRONICS

1.	Soldering guns	10 Nos.
2.	Assorted electronic components for making circuits Small PCBs	 50 Nos.
3.	Multimeters	10 Nos.
4.	Study purpose items:	10 Nos. (Telephone, FM radio, low-voltage power supply)

COURSE OUTCOMES:

Learners are able to

1. Fabricate carpentry components and pipe connections including plumbing works.
2. Use welding equipments to join the structures.
3. Carry out the basic machining operations
4. Make the models using sheet metal works
5. Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
6. Carry out basic home electrical works and appliances
7. Measure the electrical quantities
8. Elaborate on the components, gates, soldering practices.

		L	T	P	C
U20GE204	**PYTHON PROGRAMMING LABORATORY (COMMON TO ALL BRANCHES)**	**0**	**0**	**4**	**2**

Pre-requisite: Basic knowledge of install programming soft ware

COURSE OBJECTIVES

- To read, write and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- To implement functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- To get input data from/to files in Python.

LIST OF PROGRAMS

1. Write python program to compute the GCD of two numbers.
2. Write python program to Find the square root of a number (Newton‘s method).
3. Write python program to Exponentiation (power of a number).
4. Write python program to Find the maximum of a list of numbers.
5. Write python program to Linear search and Binary search.
6. Write python program to Selection sort, Insertion sort.
7. Write python program to Merge sort
8. Write python program to First n prime numbers.
9. Write python program to multiply matrices.
10. Implement python programs that take command line arguments (word count).
11. Implement python program to Find the most frequent words in a text read from a file.
12. Write python program to Simulate elliptical orbits in Pygame.
13. Write python program to Simulate bouncing ball using Pygame.

TOTAL : 60 PERIODS

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS:

HARDWARE:

1. Standalone desktops 30 Nos

SOFTWARE:

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

Learners are able to

1. Compile and execute simple Python programs.
2. Implement mathematical calculation in programs
3. Develop Python programs step-wise by defining functions and calling them.
4. Use Python lists, tuples, dictionaries for representing compound data.
5. Execute simulation of pygame programs

U20EE202	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

Pre-requisite: Basic knowledge of AC circuits ,DC circuits and Engineering Physics

COURSE OBJECTIVES

- To simulate various electric circuits using Pspice/ Matlab.
- To gain practical experience on electric circuits and verification of theorems.

LIST OF EXPERIMENTS

1. Verification of Ohm’s laws and Kirchhoff’s laws.
2. Verification of Thevenin’s and Norton’s Theorem
3. Verification of Superposition Theorem
4. Verification of Maximum Power Transfer theorem.
5. Verification of Reciprocity theorem
6. Measurement of self-inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits

TOTAL: **60 PERIODS**

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. Regulated Power Supply: 0 – 15 V D.C/ Distributed Power Source -10 Nos.
2. Function Generator (1 MHz) -10 Nos.
3. Single Phase Energy Meter -1 No.
4. Oscilloscope (20 MHz) -10 Nos.
5. Digital Storage Oscilloscope (20 MHz) -1 No.
6. PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / MATLAB /other Equivalent software Package) -10 Nos.
7. Printer -1 No
8. AC/DC - Voltmeters , Ammeters and Multi-meters -10 Nos. each
9. Single Phase Wattmeter - 3 Nos.
10. Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box - 6 Nos each.
11. Circuit Connection Boards -10 Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

COURSE OUTCOMES:

Learners are able to

1. Understand and apply circuit theorems and concepts in engineering applications.
2. Simulate electric circuits.

SEMESTER-III

		L	T	P	C
U20MA301	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**3**	**1**	**0**	**4**

Pre Requisites: Knowledge of Integral Calculus, Ordinary differential equations, Complex variables

COURSE OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Origin of partial differential equations, its order and degree, concept of solution in PDE - Solutions of standard types of first order partial differential equation - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

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.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12

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

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Understand how to solve the given standard partial differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
4. Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
5. Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3. Veerarajan, T., 'Engineering mathematics', Tata McGraw-Hill(Education) India Pvt.Ltd, 2006.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., " Engineering Mathematics" Volume III, S. Chand & Company Ltd., 2011.

REFERENCES:

1. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Venkatraman, M.K., ' Engineering Mathematics Vol.4', National publishing company, 2004.
3. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
4. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
5. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
6. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

U20EE301 ELECTRICAL MACHINES – I

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Electrical and Electronics Engineering

COURSE OBJECTIVES:

- Magnetic-circuit analysis and introduce magnetic materials
- Constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- Working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.

- Working principles of DC machines as Generator types, determination of their noload/ load characteristics, starting and methods of speed control of motors.
- Various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance.

UNIT I MAGNETIC CIRCUITS AND MAGNETIC MATERIALS 9

Magnetic circuits –Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and Dynamically induced EMF - Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation, introduction to permanent magnets- Transformer as a magnetically coupled circuit.

UNIT II TRANSFORMERS 9

Construction – principle of operation – equivalent circuit parameters – phasor diagrams, losses – testing – efficiency and voltage regulation-all day efficiency-Sumpner's test, per unit representation – inrush current - three phase transformers-connections – Scott Connection – Phasing of transformer– parallel operation of three phase transformers-auto transformer – tap changing transformers- tertiary winding.

UNIT III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES 9

Energy in magnetic system – Field energy and co energy-force and torque equations –
singly and multiply excited magnetic field systems-mmf of distributed windings – Winding Inductances-, magnetic fields in rotating machines – rotating mmf waves – magnetic saturation and leakage fluxes.

UNIT IV DC GENERATORS 9

Construction and components of DC Machine – Principle of operation - Lap and wave windings- EMF equations– circuit model – armature reaction –methods of excitation commutation - interpoles compensating winding –characteristics of DC generators.

UNIT V DC MOTORS 9

Principle and operations - types of DC Motors – Speed Torque Characteristics of DC Motors starting and speed control of DC motors –Plugging, dynamic and regenerative braking testing and efficiency – Retardation test- Swinburne's test and Hopkinson's test – Permanent Magnet DC (PMDC) motors- applications of DC Motor

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Analyze the magnetic-circuits.
2. Acquire the knowledge in constructional details of transformers.
3. Understand the concepts of electromechanical energy conversion.
4. Acquire the knowledge in working principles of DC Generator.
5. Acquire the knowledge in working principles of DC Motor and various losses taking place in D.C. Machines

TEXT BOOKS:

1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.
2. P.C. Sen,'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.
3. Nagrath, I.J. and Kothari.D.P, Electric Machines', McGraw-Hill Education, 2004

REFERENCES:

1. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.
2. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
3. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd Edition,2009.
4. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.

5. Surinder Pal Bali, 'Electrical Technology Machines & Measurements, Vol.II, Pearson,2013.
6. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill
Books Company, 2003.

U20EE302 ELECTROMAGNETIC FIELD THEORY

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Engineering Physics II and Mathematics I

COURSE OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
- Electrostatic fields, electrical potential, energy density and their applications.
- Magneto static fields, magnetic flux density, vector potential and its applications.
- Different methods of emf generation and Maxwell's equations
- Electromagnetic waves and characterizing parameters

UNIT I ELECTROSTATICS-I 9

Sources and effects of Electromagnetic Fields -Coordinate systems - Vector Fields -Gradient, Divergence and Curl -theorems and applications-coulomb's law-electric field intensity-field intensity- field due to discrete and continuous charges-gauss's law and applications.

UNIT II ELECTROSTATICS-II 9

Electric Potential - Electric field and equipotential plots ,uniform and non-uniform field, utilization factor - Electric field in free space, conductors, dielectric - Dielectric Polarization - Dielectric strength - Electric field in multiple dielectrics - Boundary conditions, Poisson's and Laplace's equations - Capacitance - Energy density, applications.

UNIT III MAGNETOSTATICS 9

Lorentz force - Magnetic field intensity (H) - Biot-Savart's Law - Ampere's Circuit Law - H due to straight conductors - Circular loop - Infinite sheet of current ,Magnetic flux density (B) - B in free space , Conductor, Magnetic materials -Magnetization, Magnetic field in multiple media - Boundary conditions, Scalar and Vector potential, Poisson's equation, Magnetic force, Torque, Inductance, Energy density, applications

UNIT IV ELECTRODYNAMIC FIELDS 9

Magnetic circuits, Faraday's laws - Transformer and Motional EMF - Displacement current- Maxwell's Equations (differential and integral forms) - Relation between Field theory and Circuit theory-applications

UNIT V ELECTROMAGNETIC WAVES 9

Electromagnetic Wave generation and equations - Wave parameters; Velocity ,Intrinsic impedance, Propagation constant - Waves in free space - Loss and lossless dielectrics, Conductors-skin depth - Pointing vector - Plane wave reflection and refraction -Standing wave-applications.

Total: 45 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Ability to understand the basic mathematical concepts related to electromagnetic vector fields.
2. Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
3. Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
4. Ability to understand the different methods of emf generation and Maxwell's equations
5. Ability to understand basic concepts electromagnetic waves and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3.Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES:

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw HillEducation(India) Private Limited, 2012.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015.

		L	T	P	C
U20EE303	**ELECTRON DEVICES AND CIRCUITS**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge of Engineering Physics and Electrical and Electronics Engineering.

COURSE OBJECTIVES:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES AND ITS APPLICATIONS 9

Formation of PN junction- Drift ad diffusion currents - biasing of PN junction- diffusion and transition capacitance- diode - structure, operation and V-I characteristic- temperature effects-diode current equation - Zener diode - structure, operation and V-I characteristics- Diode clampers and clippers- Rectifiers: HWR, FWR, BR,- filters - zener as Regulator.

UNIT II SWITCHING DEVICES 9

Transistor - construction, operation and V-I characteristic (CE, CB and CC configurations) -base-width modulation-breakdown-thermal runaway-heat sink-DC operating point and Load line-Methods of Biasing - transistor as a switch and amplifier -UJT- structure, operation and V-I characteristics-UJT based saw tooth oscillators-SCR,TRIAC and DIAC- structure, operation and V-I characteristic.

UNIT III TRANSISTOR AMPLIFIERS 9

BJT Small signal hybrid model -analysis of CE, CB and CC amplifiers- Difference Amplifier- Class A, B, C and Push-Pull Amplifier- Tuned amplifiers.

UNIT IV FIELD EFFECT TRANSISTORS 9

JFET- structure, operation and V-I characteristic - Methods of Biasing- MOSFET – types-structure, operation V-I characteristic-Zero bias and Drain feedback bias- MOSFET small signal model - analysis of CS and source follower.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Concept of feedback-types- derivation of gain-merits and demerits of negative feedback and positive feedback - negative feedback types(voltage./ current, series / shunt feedback)-input and output impedance –classification of Oscillators-equation for the oscillation-condition for oscillations- phase shift, Wien bridge, Hartley, Colpitts and crystal oscillators

Total: 45 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Explain the structure and working operation of basic electronic devices.
2. Able to identify and differentiate both active and passive elements
3. Analyze the characteristics of different electronic devices such as diodes and transistors
4. Choose and adapt the required components to construct an amplifier circuit.
5. Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS:

1. David A. Bell,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press.

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10thEdition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

U20EE304 NETWORK ANALYSIS AND SYNTHESIS

L	T	P	C
3	1	0	4

Prerequisite: Basic knowledge of Engineering Mathematics and Circuit Theory

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 12

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 12

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 12

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

UNIT IV TRANSFER FUNCTION SYNTHESIS 12

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 12

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

Students can have the ability to analyse various electrical networks in steady & transient states and also equipped to design various types of filters.

Total: 60 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Understand graph theory concepts and solve circuit theory problems
2. Apply the concept of complex frequency in studying network functions and analyse two port network parameters using various models.
3. Formulate mathematical models for RL, RC, RLC, circuit
4. Identify the given function for positive realness and synthesize reactive one port RC and RL network using Foster and Cauer methods.
5. Equipped to design various types of filters.

TEXT BOOKS:

1. Ravish R. Singh, “Network Analysis and Synthesis”, TMH, New Delhi, 1st Edition, 2013.
2. Sudhakar A. and Shyammohan S.P., "Circuits and Networks: Analysis and Synthesis", TMH, New Delhi, 2011.
3. Roy D.Choudhury, "Networks and Systems", New Age Publications, New Delhi, 4th Edition, 2010.

REFERENCES:

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)
3. M.E.Van Valkenberg, “Introduction to Modern Network Synthesis”, Wiley Eastern;.
4. Umesh Sinha “Network Analysis and Synthesis”Satya Prakashan Publishers, 4th Edition 2013
5. David A Bell,”Electric Circuits Oxford Press, “, (7thEdition, 2011)

U20EE305 DIGITAL LOGIC CIRCUITS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Electrical and Electronics Engineering

COURSE OBJECTIVES:

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Asynchronous sequential logic circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL 9

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Ability to design combinational and sequential Circuits.
2. Ability to study various number systems and simplify the logical expressions using Boolean functions
3. Ability to design various synchronous and asynchronous circuits.
4. Ability to introduce asynchronous sequential circuits and PLDs
5. Ability to simulate using software package, digital simulation for development of application oriented logic circuits.

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCES:

1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

U20EE306	ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

Prerequisite: Basic knowledge of Circuits and Networks, Electron Devices and Circuits

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Understand and analyse electronic circuits**.**
2. Understand the characteristics of semiconductor devices
3. Acquire knowledge on CRO
4. Acquire knowledge on filters
5. Study the light activated relay circuit

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photo diode, Photo Transistor	
2. Resistors, Capacitors and inductors	
3. Necessary digital IC 8	
4. Function Generators	10 Nos
5. Regulated 3 output Power Supply 5, ± 15V	10 Nos
6. CRO	10 Nos
7. Storage Oscilloscope	1 No
8. Bread boards	
9. Atleast one demo module each for the listed equipments.	
10. Component data sheets to be provided	

U20EE307	**ELECTRICAL MACHINES LABORATORY – I**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Electrical and Electronics Engineering

COURSE OBJECTIVES:

- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne’s test and speed control of DC shunt motor.
7. Hopkinson’s test on DC motor – generator set.

8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12. Study of starters and 3-phase transformers connections**.**

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Leaners are able to:

1. Understand and analyze DC Generator
2. Understand and analyze DC Motor
3. Understand and analyze Transformers**.**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	DC Shunt Motor with Loading Arrangement	3 nos
2.	DC Shunt Motor Coupled with Three phase Alternator	1 No.
3.	Single Phase Transformer	4 nos
4.	DC Series Motor with Loading Arrangement	1 No.
5.	DC compound Motor with Loading Arrangement	1 No.
6.	Three Phase Induction Motor with Loading Arrangement	2 nos
7.	Single Phase Induction Motor with Loading Arrangement	1 No.
8.	DC Shunt Motor Coupled With DC Compound Generator	2 nos
9.	DC Shunt Motor Coupled With DC Shunt Motor	1 No.
10.	Tachometer -Digital/Analog	8 nos
11.	Single Phase Auto Transformer	2 nos
12.	Three Phase Auto Transformer	1 No.
13.	Single Phase Resistive Loading Bank	2 nos
14.	Three Phase Resistive Loading Bank.	2 nos

SEMESTER-IV

U20MA404	**STATISTICS AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Pre-requisite: Basic Knowledge of Differentiation, Integrations & Statistics

COURSE OBJECTIVES

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT II DESIGN OF EXPERIMENTS 12

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Apply the concept of testing of hypothesis for small and large samples in real life problems.
2. Apply the basic concepts of classifications of design of experiments in the field of agriculture.
3. Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
4. Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5. Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS :

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., Miller and Freund's "Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3. Veerarajan. T., "Probability, Statistics and Random Processes", 3rd Edition , Tata McGraw Hill, 2008.

REFERENCES :

1. Kandasamy P., Thilagavathy K., and Gunavathy K., " Numerical Methods ", S. Chand Co. Ltd., 2010.
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
4. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
5. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

U20EE401	ELECTRICAL MACHINES II	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Engineering Physics and Electrical Engineering

COURSE OBJECTIVES:

- Construction and performance of salient and non – salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details – Types of rotors –winding factors- emf equation – Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation – Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – steady state power- angle characteristics– Two reaction theory –slip test -short circuit transients - Capability Curves

UNIT II SYNCHRONOUS MOTOR 9

Principle of operation – Torque equation – 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 – natural frequency of oscillations – damper windings- synchronous condenser.

UNIT III THREE PHASE INDUCTION MOTOR 9

Constructional details – Types of rotors –- Principle of operation – Slip –cogging and crawling- Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors – Induction generators – Synchronous induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 9

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star delta starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the construction and working principle of Synchronous Generator
2. Understand MMF curves and armature windings.
3. Understand the construction and working principle of Synchronous motor and Three phase Induction Motor
4. Understand the construction and working principle of Special Machines
5. Predetermine the performance characteristics of Synchronous Machines.

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 2003.
2. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals'4th edition, McGraw Hill Education Pvt. Ltd, 2010.

REFERENCES:

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.
3. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
4. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers,3rd Edition ,Reprint 2015.
5. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
6. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001.

U20EC301	SIGNALS AND SYSTEMS	L	T	P	C
		3	1	0	4

Prerequisite: Basic knowledge of Integration, Differentiation & Complex Numbers.

COURSE OBJECTIVES:

- Understand about various types of signals and systems, classify them, analyze them and perform various operations.
- Representation of periodic functions.
- Realize use of transforms in analysis of signals and system.
- Characterize LTI systems in the Time domain
- Characterize LTI systems in the various Transform domains

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 12

Basic definitions - Classification of signals and systems - Signal operations and properties - Basic continuous time signals - signal sampling and quantization - discretization of continuous time signals - discrete time signals - Basic system properties - Representation of digital signals - Case study of different signals form communication and biomedical field.

UNIT II ANALYSIS OF CONTINOUS TIME SIGNALS 12

Representation of periodic functions - Fourier series - Fourier Transform - Laplace Transform - Relation between Laplace Transform and Fourier Transform – Transform properties.

UNIT III ANALYSIS OF DISCRETE TIME SIGNALS 12

DTFT- Properties of DTFT- Z Transform - Convergence of Z-Transform - Properties of Z-Transform - Inverse Z-Transform and solving difference equation using Z-Transform.

UNIT IV LINEAR TIME INVARIANT - CT SYSTEMS 12

Impulse response characterization and convolution integral for CT-LTI system - Properties of convolution - Fourier and Laplace transforms in analysis of CT systems - Block diagram representation.

UNIT V LINEAR TIME INVARIANT - DT SYSTEMS 12

Impulse response characterization and convolution sum – DTFT and Z transform analysis of recursive and non-recursive systems - Block diagram representation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Analyze the properties of signals & systems.
2. Analyze CT and DT signal.
3. Apply Fourier transform, Laplace transform and Z transform in signal analysis.
4. Analyze continuous time LTI systems using Fourier and Laplace Transforms.
5. Analyze discrete time LTI systems using Z transform.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson limited,2013
2. Tarun Kumar Rawat Signals and Systems Oxford University press, 2010

REFERENCES:

1. John Alan Stuller, An Introduction to Signals and Systems, Nelson, 2007
2. M.J.Roberts, Signals & Systems Analysis using Transform Methods & MATLAB, Tata McGraw Hill.2011
3. B.P Lathi Roger Green Signal processing and Linear Systems- Oxford University, press 2021.

U20EE402	MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Engineering Physics and Circuit Theory

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION TO BASICS OF INSTRUMENTS 9

Functional Element of Generalized Measurement System - Static and Dynamic Characteristics - Measurement Standards -Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Measurement of Voltage and Current - PMMC Instruments - Moving Iron Instruments - Dynamometer Type Wattmeter – Instrument Transformers - Induction Type Energy Meter - Determination of BH Curve and Hysteresis Loop –Electrodynamometer Power Factor Meter - Weston Frequency Meter Synchroscope - Megger.

UNIT III COMPARATIVE METHODS OF MEASUREMENTS 9

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

UNIT IV STORAGE AND DISPLAY DEVICES 9

Multiplexing- Time Division Multiplexing - Frequency Division Multiplexing, Galvanometer Type Recorders – Potentiometer Recorders - X - Y Recorder - Digital Tape Recorder - Dot Matrix Displays, CRO,Analog CRO, Digital Storage Oscilloscope - Multichannel Storage Oscilloscope – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers - Resistive Potentiometers - L.V.D.T - Variable Inductance and Capacitance Transducers - Piezo Electrical Transducers - Hall Effect Transducer - Opto Electronic Transducers– Elements of data acquisition system – Smart sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. To acquire knowledge on Basic functional elements of instrumentation
2. To understand the concepts of Fundamentals of electrical and electronic instruments
3. Ability to compare between various measurement techniques
4. To acquire knowledge on Various storage and display devices
5. To understand the concepts Various transducers and the data acquisition systems

TEXT BOOKS:

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

REFERENCES:

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, ' Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.
6. http://nptel.ac.in/courses/108105064/

U20EE403 TRANSMISSION AND DISTRIBUTION

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Circuits and Networks, Electromagnetic Theory

COURSE OBJECTIVES:

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of cabilitys and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

UNIT I TRANSMISSION LINE PARAMETERS 9

Structure of Power System - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition – application of self and mutual GMD; skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines.

UNIT II MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9

Performance of Transmission lines - short line, medium line and long line – equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines – Power Circle diagrams - Formation of Corona – Critical Voltages – Effect on Line Performance.

UNIT III MECHANICAL DESIGN OF LINES 9

Mechanical design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

UNIT IV UNDER GROUND CABLES 9

Underground cables - Types of cables – Construction of single core and 3 core cables - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables – DC cables.

UNIT V DISTRIBUTION SYSTEMS AND TRANSMISSION CONTROLLERS 9

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement – Distribution Loss –Types of Substations -Methods of Grounding – Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the importance and the functioning of transmission line parameters.
2. Understand the concepts of Lines and Insulators and acquire knowledge on the performance of Transmission lines.
3. Understand the importance of distribution of the electric power in power system.
4. acquire knowledge on Underground Cabilitys
5. Become familiar with the function of different components used in Transmission and Distribution levels of power system and modelling of these components.

TEXT BOOKS:

1. D.P.Kothari, I.J. Nagarath, 'Power System Engineering', Mc Graw-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.

REFERENCES:

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Arun Ingole, "power transmission and distribution" Pearson Education, 2017
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013

U20EE404 LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Electronic devices

COURSE OBJECTIVES:

- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT I CHARACTERISTICS OF OPAMP 9

Classification of Integrated Circuits - Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current - Compensation, Inverting and non-inverting Amplifiers.

UNIT II APPLICATIONS OF OPAMP 9

Summer, differentiator and integrator - Voltage comparators - Instrumentation amplifier, V/I & I/V converters, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT III DESIGN WITH OPAMP 9

First and second order active filters - Oscillators - Waveform generator - Schmitt trigger- multivibrators.

UNIT IV SPECIAL ICs 9

555 Timer circuit - Functional block, characteristics & applications; 566-voltagecontrolledoscillator circuit; 565-phase lock loop circuit functioning and applications, Analog multiplier ICs.

UNIT V APPLICATION OF ICs 9

Voltage regulators - IC 7805 - IC 723 - Switched capacitor filters - switching regulator, MA 7840, LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs.

Total: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Acquire knowledge in IC fabrication procedure
2. Analyze the characteristics of Op-Amp and Applications of Op-amp
3. Understand the importance of Signal analysis using Op-amp based circuits.
4. Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
5. Understand and analyse, linear integrated circuits their Fabrication and Application.

TEXT BOOKS:

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003/PHI. 2000.

REFERENCES:

1. Fiore,"Opamps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', Mc Graw Hill, 2016.
6. Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2011.

U20EE405	ELECTRICAL MACHINES LABORATORY – II	L	T	P	C
		0	0	4	2

Prerequisite: Basic knowledge of Electrical machines

COURSE OBJECTIVES:

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

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. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).

8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Learners are able to:

1. Understand and analyze EMF and MMF methods
2. Analyze the characteristics of V and Inverted V curves
3. Understand the importance of Synchronous machines
4. Understand the importance of Induction Machines
5. Acquire knowledge on separation of losses

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Synchronous Induction motor 3HP	1 No.
2.	DC Shunt Motor Coupled With Three phase Alternator	4 nos
3.	DC Shunt Motor Coupled With Three phase Slip ring Induction motor	1 No.
4.	Three Phase Induction Motor with Loading Arrangement	2 nos
5.	Single Phase Induction Motor with Loading Arrangement	2 nos
6.	Tachometer -Digital/Analog	8 nos
7.	Single Phase Auto Transformer	2 nos
8.	Three Phase Auto Transformer	3 nos
9.	Single Phase Resistive Loading Bank	2 nos
10.	Three Phase Resistive Loading Bank	2 nos
11.	Capacitor Bank	1 No

U20EE406 LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	4	2

Prerequisite: Basics of Electrical and Electronics Engineering Laboratory & Electron Devices and Circuits

COURSE OBJECTIVES:

- To learn design, testing and characterizing of circuit behaviour with digital and analog ICs.

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking
4. Encoders and Decoders
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/ SE 566 IC.
11. Variability Voltage Regulator using IC LM317.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand and implement Boolean Functions.
2. Understand the importance of code conversion
3. Design and implement 4-bit shift registers
4. Acquire knowledge on Application of Op-Amp
5. Design and implement counters using specific counter IC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Dual ,(0-30V) variability Power Supply	10	-
2.	CRO	9	30MHz
3.	Digital Multimeter	10	Digital
4.	Function Generator	8	1 MHz
5.	IC Tester (Analog)	2	
6.	Bread board	10	
7.	Computer (PSPICE installed)	1	

Consumabilitys (sufficient quantity)

1. IC 741/ IC NE555/566/565
2. Digital IC types
3. LED
4. LM317
5. LM723
6. ICSG3524 / SG3525
7. Transistor – 2N3391
8. Diodes, IN4001,BY126
9. Zener diodes
10. Potentiometer
11. Step-down transformer 230V/12-0-12V
12. Resistors 1/4 Watt Assorted, Capacitors, Single Strand Wire etc.

SEMESTER-V

U20EE501 **POWER SYSTEM ANALYSIS**

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Circuits and Networks**,** Numerical Methods, Transmission and Distribution

COURSE OBJECTIVES:

- To model the power system under steady state operating condition
- To understand and apply iterative techniques for power flow analysis
- To model and carry out short circuit studies on power system
- To model and analyze stability problems in power system

UNIT I POWER SYSTEM **9**

Need for system planning and operational studies - Power scenario in India - Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters - Representation of off nominal transformer - Formation of bus admittance matrix of large power network.

UNIT II POWER FLOW ANALYSIS 9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method and Fast Decouple Method**.**

UNIT III SYMMETRICAL FAULT ANALYSIS 9

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) – Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level – Current limiting reactors.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS 9

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system - computation of post fault currents in symmetrical component and phasor domains.

UNIT V STABILITY ANALYSIS 9

Classification of power system stability – Rotor angle stability - Swing equation – Swing curve - Power-Angle equation - Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – modified Euler method.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Model the power system under steady state operating condition
2. Understand and apply iterative techniques for power flow analysis
3. Model and carry out short circuit studies on power system
4. Model and analyze stability problems in power system
5. Model and analyze unsymmetrical faults in power system

TEXT BOOKS:

1. John J. Grainger, William D. Stevenson.Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition,2008.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES:

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd.,New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
4. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

U20EE502	CONTROL SYSTEMS	L	T	P	C
		3	1	0	4

Prerequisite: Basic knowledge of Mathematics, Science and Engineering fundamentals.

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 stability analysis and design of compensators

UNIT I SYSTEMS AND REPRESENTATION 12

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

UNIT II TIME RESPONSE 12

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

UNIT III FREQUENCY RESPONSE 12

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

UNIT IV STABILITY AND COMPENSATOR DESIGN 12

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response- Tuning of P, PI and PID controllers Design of Lag, lead and lag lead compensator using bode plots.

UNIT V STATE VARIABLE ANALYSIS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
2. Time domain and frequency domain analysis of various models of linear system.
3. Interpret characteristics of the system to develop mathematical model.
4. Design appropriate compensator for the given specifications.
5. Come out with solution for complex control problem.
6. Understand use of PID controller in closed loop system.

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2.Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

REFERENCES:

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.

4. Rames C.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

U20EE503	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Electronic devices and circuits

COURSE OBJECTIVES:

- Different types of power semiconductor devices and their switching Operation.
- Characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- Operation of AC voltage controller and various configurations.

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

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

UNIT II PHASE-CONTROLLED CONVERTERS 9

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

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both1200mode and1800mode) – Voltage & harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, Modified Sinusoidal PWM - Introduction to space vector modulation – Current source inverter, Applications – Induction Heating ,UPS – PSK method of online UPS.

UNIT V AC TO AC CONVERTERS 9

Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters -Introduction to Matrix converters, Applications –welding .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Analyse of AC-DC converters.
2. Analyse of DC-DC converters
3. Analyse of DC-AC Inverters.
4. Analyse of AC-AC converters.
5. Choose the converters for real time applications.

TEXT BOOKS:

1. M.H.Rashid, ‘Power Electronics: Circuits, Devices and Applications’, Pearson Education, PHI Third Edition, New Delhi, 2004.
2. P.S.Bimbra “Power Electronics” Khanna Publishers, third Edition, 2003.
3. L. Umanand, “ Power Electronics Essentials and Applications”, Wiley, 2010.

REFERENCES:

1. Joseph Vithayathil,"Power Electronics, Principles and Applications", McGraw Hill Series, 6thReprint, 2013.
2. Ashfaq Ahmed,"Power Electronics for Technology Pearson Education", Indian reprint, 2003.
3. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
4. Ned Mohan, Tore. M. Undel and, William. P. Robbins,"Power Electronics: Converters, Applications and Design", John Wiley and sons, third edition,2003.
5. Daniel.W.Hart, "Power Electronics", Indian Edition, Mc Graw Hill, 3rd Print, 2013.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.

WEB RESOURCES:

- https://youtu.be/dfXJTY_PSBE

U20EE504	INTERNET OF THINGS BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of

COURSE OBJECTIVES:

- To introduce the physical, logical design and components of IoT
- To outline the global context of M2M and IoT
- To provide an overview of IoT architecture
- To learn to program Arduino microcontroller for IoT
- To cover real-world implementation examples of IoT.

UNIT I INTRODUCTION TO IoT **9**

Definition and characteristics of IoT - Physical and logical design of IoT - IoT enabling technologies - IoT levels & deployment templates - IoT design methodology - Components of Internet of Thing devices: Control units – Sensors – Communication modules – Power sources. Communication technologies: RFID – Bluetooth – ZigBee – Wi-Fi – RFlinks – Mobile Internet – Wired Communication. Safety – privacy – trust - security model.

UNIT II M2M AND IoT **9**

Machine-to-Machine (M2M) communication – IoT – M2M towards IoT – Main characteristics of M2M and IoT – Global value chains – Ecosystem – M2M and IoT value chains – Main design principles and needed capabilities - An IoT architecture outline - Standardizations around M2M and IoT.

UNIT III IoT ARCHITECTURE **9**

European Telecommunications Standards Institute (ETSI) model – International Telecommunication Union- Telecommunication (ITU-T) IoT model – Internet Engineering Task Force (IETF) IoT model – Open Geospatial Consortium (OGC) architecture – IoT domain model – IoT information model – IoT functional model – IoT communication model**.**

UNIT IV IoT PROGRAMMING **9**

Basics of sensors and actuators – Examples and working principles of sensors and actuators Arduino/Equivalent Microcontroller platform – Programming for IoT – Reading from sensors. Communication: Connecting microcontroller with Bluetooth and USB – Connection with the Internet using Ethernet

UNIT V IoT APPLICATIONS **9**

Asset Management: Introduction - Expected benefits - e-Maintenance in the M2M era - Hazardous goods management in the M2M era. Industrial automation: Service-oriented architecture-based device integration - SOCRADES: realizing the enterprise integrated Web of Things - IMC-AESOP: from the Web of Things to the Cloud of Things. Smart Grid: Smart metering - Smart house - Smart energy city. Smart cities: Need – definition – examples - Roles, actors, engagement - Transport and logistics-an IoT perspective.

COURSE OUTCOMES:

Learners are able to:

1. Acquire knowledge in physical, logical design and components of IoT
2. Need & use of M2M and IoT.
3. Need & use of Arduino microcontroller for IoT.
4. Acquire Knowledge on IoT Programming.
5. Acquire Knowledge on IoT real time applications.

TEXT BOOKS:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-On Approach”, VPT Publisher, 2014.
2. Charalampos Doukas, “Building Internet of Things with the Arduino”, Create space, April 2002.
3. Jan HÖller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand and David Boyle, “From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence”, Academic Press, 2014.

REFERENCES:

1. Jean-Philippe Vasseur and Adam Dunkels “Interconnecting Smart Objects with IP: The Next Internet”, Morgan Kaufmann Publishers, 2010.

U20EE505 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Computer Programming

COURSE OBJECTIVES:

- Architecture of µP8085 & µC 8051
- Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Simple applications development with programming 8085
- Simple applications development with programming 8051

UNIT I 8085 PROCESSOR **9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Introduction to 8086 Processor.

UNIT II PROGRAMMING OF 8085 PROCESSOR **9**

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER **9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING **9**

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS **9**

Simple programming exercises- key board and display interface –Control of servo motor stepper motor control- Application to automation systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
2. Need & use of Interrupt structure 8085 & 8051.
3. Understand the importance of Interfacing
4. Explain the architecture of Microprocessor and Microcontroller.
5. Write the assembly language programme and Microprocessor and Microcontroller based applications.

TEXT BOOKS:

1. Sunil Mathur &Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCES:

1. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM,” Computer Fundamentals Architecture and Organization” New Age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, ‘Microcontroller Theory &Applications’, McGraw Hill Edu,2016
5. Douglas V.Hall, ‘Microprocessor and Interfacing’, McGraw Hill Edu, 2016.

U20EE506	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

Prerequisite: Basic knowledge of Measurement Instrumentation and control system

COURSE OBJECTIVES:

- To provide knowledge on analysis and design of control system along with basics of instrumentation.

LIST OF EXPERIMENTS:

CONTROLSYSTEMS:

1. P, PI and PID controllers
2. Stability Analysis
3. Modeling of Systems – Machines, Sensors and Transducers
4. Design of Lag, Lead and Lag-Lead Compensators
5. Position Control Systems
6. Frequency response and Time response plots using MATLAB.

INSTRUMENTATION:

7. Bridge Networks –AC and DC Bridges
8. Dynamics of Sensors/Transducers

(a) Temperature (b) pressure (c) Displacement (d) Optical (e) Strain (f) Flow

9. Power and Energy Measurement
10. Signal Conditioning
    (a) Instrumentation Amplifier
    (b) Analog – Digital and Digital –Analog converters (ADC and DACs)
11. Process Simulation

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand control theory and apply them to electrical engineering problems.
2. Analyze the various types of converters.
3. Understand the basic concepts of bridge networks.
4. Basics of signal conditioning circuits.
5. Design compensators and study the simulation packages.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CONTROLSYSTEMS:

1. PID controller simulation and learner kit	1 No.
2. Digital storage Oscilloscope for capturing transience	1 No
3. Personal Computer with control system simulation packages	10 Nos
4. DC motor –Generator test set-up for evaluation of motor parameters	
5. CRO 30MHz	1 No.
6. 2MHz Function Generator	
7. Position Control Systems Kit (with manual)	1 No.,
8. Tacho Generator Coupling set	1No.
9. Sufficient number of Digital multi meters, speed and torque sensors	

INSTRUMENTATION:

1. R, L, C Bridge kit (with manual)	
2. a) Electric heater	1No.
Thermometer	1No.
Thermistor (silicon type) RTD nickel type	1No.
b) 30 psi Pressure chamber (complete set)	1No.
Current generator (0 – 20mA) Air foot pump	1 No.
(with necessary connecting tubes)	
c) LVDT20mm core length movability type –	1No.
CRO 30MHz	1No.
d) Optical sensor	1 No.
Light source	
e) Strain Gauge Kit with Handy lever beam	1No.
100gm weights	10 nos
f) Flow measurement Trainer kit	1 No.
(1/2 HP Motor, Water tank, Digital Millimeter, complete set)	
3. Single phase Auto transformer	1No.
Watt-hour meter (energy meter)	1No.
Ammeter Voltmeter Rheostat Stop watch	
Connecting wires (3/20)	
4. IC Transistor kit	1No.
5. Instrumentation Amplifier kit	1 No
6. Analog – Digital and Digital –Analog converters (ADC and DACs)	1 No

		L	T	P	C
U20EE507	**MICROPROCESSOR AND MICROCONTROLLER LABORATORY**	**0**	**0**	**4**	**2**

Prerequisite: Basic knowledge of Microprocessor and Microcontroller

COURSE OBJECTIVES:

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   (i) Ascending / Descending order, Maximum / Minimum of numbers.
   (ii) Programs using Rotate instructions.
   (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   (i) A/D Interfacing.
   (ii) D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key, interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
   (i) Conditional jumps & looping
   (ii) Calling subroutines.
9. Programming I/O Port and timer of 8051
   (i) study on interface with A/D & D/A
   (ii) Study on interface with DC & AC motors
10. Application hardware development using embedded processors.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand and apply computing platform and software for engineering problems.
2. Programming logics for code conversion.
3. Acquire knowledge on A/D and D/A.
4. Understand basics of serial communication and basics of software simulators. .
5. Understand and impart knowledge in DC and AC motor interfacing.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	8085 Microprocessor Trainer with Power Supply	15 Nos
2.	8051 Micro Controller Trainer Kit with power supply	15 Nos
3.	8255 Interface boards	5 Nos
4.	8251 Interface boards	5 Nos
5.	8259 Interface boards	5 Nos
6.	8279 Keyboard / Display Interface boards	5 Nos
7.	8254 timer/ counters	5 Nos
8.	ADC and DAC cards	5 Nos
9.	AC & DC motor with Controller s	5 Nos
10.	Traffic Light Control Systems	5 Nos

SEMESTER-VI

U20EE601 EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Microprocessor and Microcontrollers

COURSE OBJECTIVES:

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand and analyze embedded systems and basics of Real time operating system.
2. Suggest an embedded system for a given application.
3. Operate various Embedded Development Strategies
4. Study about the bus Communication in processors.
5. Acquire knowledge on various processor scheduling algorithms.

TEXT BOOKS:

1. Peckol, “Embedded system Design”, John Wiley & Sons,2010
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
3. Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.

REFERENCES

1. Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2. C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4. Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

U20EE602 DESIGN OF ELECTRICAL APPARATUS

L	T	P	C
3	1	0	4

Prerequisite: Basic knowledge of Electrical and Electronics Engineering, Electrical Machines – I, Electrical Machines - II

COURSE OBJECTIVES:

- 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 I INTRODUCTION 12

Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise - Rating of machines – Standard specifications.

UNIT II DC MACHINES 12

Output Equations – Main Dimensions - Magnetic circuit calculations – Carter's Coefficient – Net length of Iron –Real & Apparent flux densities – Selection of number of poles – Design of Armature – Design of commutator and brushes – performance prediction using design values.

UNIT III TRANSFORMERS 12

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 IV INDUCTION MOTORS 12

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 – Circle diagram - Operating characteristics.

UNIT V SYNCHRONOUS MACHINES 12

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 of rotor – Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand basics of design considerations for rotating and static electrical machines and application of field systems.
2. Design sings and three phase transformer.
3. Design armature and field of DC machines.
4. Design stator and rotor of induction motor.
5. Design and analyze synchronous machines.

TEXT BOOKS:

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2. M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCES:

1. A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
2. 'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited,1981.
3. V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
4. K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008.

U20EE603 POWER SYSTEM OPERATION AND CONTROL

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Transmission and Distribution System

COURSE OBJECTIVES:

- Significance of power system operation and control.
- Real power-frequency interaction and design of power-frequency controller.
- Reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- Economic operation of power system.
- SCADA and its application for real time operation and control of power systems

UNIT I PRELIMINARIES ON POWER SYSTEM OPERATION AND CONTROL 9

Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - necessity of voltage and frequency regulation – real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel.

UNIT II REAL POWER - FREQUENCY CONTROL 9

Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling – block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variability model - integration of economic dispatch control with LFC.

UNIT III REACTIVE POWER – VOLTAGE CONTROL 9

Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

UNIT IV ECONOMIC OPERATION OF POWER SYSTEM 9

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem – solution of UC problem using priority list – special aspects of short term and long term hydrothermal problems-Dynamic Programming Method.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the day-to-day operation of electric power system and significance of power system operation and control.
2. Analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
3. Acquire knowledge on real power-frequency interaction.
4. Understand the reactive power-voltage interaction.
5. Design SCADA and its application for real time operation.

TEXT BOOKS:

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

REFERENCES:

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.
4. https://powermin.gov.in/en/content/indian-electricity-scenario

U20EE604 PROTECTION AND SWITCHGEAR

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Electrical Machines

COURSE OBJECTIVES:

- Causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- Characteristics and functions of relays and protection schemes.
- Apparatus protection of generation, Transmission and distribution systems
- static and numerical relays
- Functioning of circuit breaker

UNIT I PROTECTION SCHEMES **9**

Principles and need for protective schemes – nature and causes of faults – types of faults – Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme

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, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand and analyze Electromagnetic and Static Relays.
2. Find the causes of abnormal operating conditions of the apparatus and system.
3. Analyze the characteristics and functions of relays and protection schemes.
4. Study about the apparatus protection, static and numerical relays.
5. Acquire knowledge on functioning of circuit breaker and suitability circuit breaker.

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2017.

REFERENCES:

1. BadriRam ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age InternationalPvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition,Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. RavindraP.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., NewDelhi, 2009.
5. VK Metha," Principles of Power Systems" S. Chand, 2005.

U20EE605	**POWER ELECTRONICS AND DRIVES LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Electronic Devices and circuits

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Gate Pulse Generation using R, RC and UJT.
2. Characteristics of SCR and TRIAC
3. Characteristics of MOSFET and IGBT
4. AC to DC half controlled converter
5. AC to DC fully controlled Converter
6. Step down and step up MOSFET based choppers
7. IGBT based single phase PWM inverter
8. IGBT based three phase PWM inverter
9. AC Voltage controller
10. Switched mode power converter.
11. Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-D converters, AC voltage controllers).
12. Characteristics of GTO & IGCT.
13. Characteristics of PMBLDC motor

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Practice and understand converter and inverter circuits and apply software for engineering problems.
2. Experiment about switching characteristics various switches.
3. Analyze about AC to DC and DC to AC converter circuits.
4. Acquire knowledge on AC to AC converters
5. Acquire knowledge on simulation software.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Device characteristics(for SCR, MOSFET, TRIAC,GTO,IGCT and IGBT kit with built-in / discrete power supply and meters)	2 each
2.	Single phase SCR based half controlled converter and Fully controlled converter along with built-in/ separate/firing circuit/module and meter	2 each
3.	MOSFET based step up and step down choppers (Built in/ Discrete)	1 each
4.	IGBT based single phase PWM inverter module/Discrete Component	2 Nos
5.	IGBT based three phase PWM inverter module/Discrete Component	2 Nos
6.	Switched mode power converter module/Discrete Component	2 Nos
7.	SCR &TRIAC based 1 phase AC controller along with lamp or rheostat load	2 Nos
8.	Cyclo converter kit with firing module	1 Nos
9.	Dual regulated DC power supply with common ground	
10.	Cathode ray Oscilloscope	10 Nos
11.	Isolation Transformer	5 Nos
12.	Single phase Auto transformer	3 Nos
13.	Components (Inductance, Capacitance)	3 set for each
14.	Multimeter	5 Nos
15.	LCR meter	3 Nos
16.	Rheostats of various ranges	2 sets of 10 value
17.	Work tabilitys	10 Nos
18.	DC and AC meters of required ranges	20 Nos
19.	Component data sheets to be provided	

U20EE606	**POWER SYSTEM SIMULATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

Prerequisite: Basic knowledge of Transmission and Distribution, Power System Analysis and Stability

COURSE OBJECTIVES:

- To provide better understanding of power system analysis through digital simulation.

LIST OF EXPERIMENTS

1. Computation of Transmission Line Parameters
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks
3. Power Flow Analysis using Gauss-Seidel Method
4. Power Flow Analysis using Newton Raphson Method
5. Symmetric and unsymmetrical fault analysis
6. Transient stability analysis of SMIB System
7. Economic Dispatch in Power Systems
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. State estimation: Weighted least square estimation
10. Electromagnetic Transients in Power Systems: Transmission Line Energization.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand power system planning and operational studies.
2. Acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Analyze the power flow using GS and NR method and electromagnetic transients
4. Find Symmetric and Unsymmetrical fault
5. Understand the economic dispatch.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Personal computers (Intel i3, 80GB, 2GBRAM)	30 Nos
2. Printer laser	1 No.
3. Dot matrix	1 No.
4. Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor)	1 No.
5. Software: any power system simulation software with 5 user license	
6. Compliers: C, C++, VB, VC++	30 users

U20HS501	PROFESSIONAL COMMUNICATION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.
- Strengthen their prospects of success in competitive examinations.

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Verbal Ability.

COURSE OUTCOMES:

Learners are able to:

1. Make effective presentations
2. Participate confidently in Group Discussions.
3. Attend job interviews and be successful in them.
4. Develop adequate Soft Skills required for the workplace
5. English Language Testing systems

Recommended Software

1. Globearena
2. Win English

REFERENCES:

1. Peter, Francis. Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill. 2012. Print.
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Robert M Sherfield and et al. "Developing Soft Skills" 4th edition, New Delhi: Pearson Education, 2009..
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University
5. Press: Oxford, 2014
6. Roberts, Rachael, Joanne Gakonga, and Andrew Preshous (2004) IELTS Foundation: Study Skills. Oxford: Macmillan Education.

TOTAL: 30 PERIODS

SEMESTER-VII

U20EE701	RENEWABLE ENERGY SYSTEM	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Engineering Physics and Chemistry

COURSE OBJECTIVES:

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.
- Awareness about Biomass energy
- Acquire knowledge on alternate energy sources

UNIT I RENEWABLE ENERGY (RE) SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy,Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II WIND ENERGY 9

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III SOLAR PV AND THERMAL SYSTEMS 9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

UNIT IV BIOMASS ENERGY 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of
water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT V OTHER ENERGY SOURCES 9

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Create awareness about renewable Energy Sources and technologies.
2. Get adequate inputs on a variety of issues in harnessing renewable Energy.
3. Recognize current and possible future role of renewable energy sources.
4. Explain the various renewable energy resources and technologies and their applications.
5. Acquire knowledge about solar energy and biomass energy.

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, ‘Wind Power Plants and Project Development’, PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan “Renewable Energy Sources and Emerging Technologies”, PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, “Renewable Energy & Sustainable Design”, CENGAGE Learning, USA, 2016.

REFERENCES

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig,Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.

U20EE702 SOLID STATE DRIVES

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Power Electronics and Electrical Machines

COURSE OBJECTIVES:

- Steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- Operation and performance of Induction motor drives.
- Operation and performance of Synchronous motor drives.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

UNIT I DRIVE CHARACTERISTICS 9

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor.

UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 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.

UNIT III INDUCTION MOTOR DRIVES 9

Stator voltage control–V/f control– Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control— vector control- Applications.

UNIT IV SYNCHRONOUS MOTOR DRIVES 9

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

UNIT V DESIGN OF CONTROLLERS FOR 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

COURSE OUTCOMES:

Learners are able to:

1. Understand and suggest a converter for solid state drive.
2. Select suitability drive for the given application.
3. Study about the steady state operation and transient dynamics of a motor load system.
4. Analyze the operation of the converter/chopper fed dc drive and AC motor drives.
5. Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001.

REFERENCES:

1. Vedam Subramanian, " Electric Drives Concepts and Applications ", 2e, McGraw Hill, 2016
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
3. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier2012.
4. Theodore Wildi, " Electrical Machines ,Drives and power systems ,6th edition, PearsonEducation ,2015

U20EE703 UTILIZATION OF ELECTRICAL ENERGY

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of Electrical Machines and Power System

COURSE OBJECTIVES:

- To make the students aware about the importance of maximizing the energy efficiency by optimum utilization of electrical energy.
- To impart knowledge on Principle and design of illumination systems
- To impart knowledge on Electric traction systems and their performance.
- To analyze the performance of and different methods of electric heating and electric welding.
- Acquire knowledge on conservation of electrical energy

UNIT I ILLUMINATION 9

Laws of illumination - Calculation of illumination - Street lighting and Flood lighting - MSCP - Choice of Lighting - Different types of illumination sources and Energy efficiency - Control of Lighting - Lighting standards for industry and Commercial – Energy conservation measures for lighting.

UNIT-II ELECTRIC TRACTION 9

Choice of an Electric Motor - Traction Motors - Characteristic - Systems of railway electrification - Power and Energy output from driving axles - Specific Energy output and consumption - Electric Braking - System of railway electrification - Aircraft electrical system

UNIT III ELECTRIC HEATING AND WELDING 9

Introduction –Requirement of heating material – Design of heating element – Methods of heating — Induction Heating – Dielectric Heating – Electric Arc Furnaces- Electric Welding –Types of Resistance welding – Welding transformer.

UNIT IV ELECTRICAL ENERGY AUDIT 9

Electricity billing, Electrical load management and Maximum demand control, Energy efficiency in electrical system and Energy audit - Energy conservation Act 2001 and its features - Energy and Demand charges - Transmission and Distribution losses -Reactive power management for power factor correction - Environment and Climate change - Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM - Bachat Lamp Yojna and Industry; Prototype Carbon Fund (PCF).

UNIT V CONSERVATION OF ELECTRICAL ENERGY 9

Energy Conservation potential in motors - Pumps - Fans and Compressors - Refrigeration and HVAC system, operation and maintenance practices for electrical energy conservation - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the concept behind illumination and design a suitable illumination system for a specific application.
2. Understand the basic knowledge about electric traction system.
3. Understand the economic aspects connected with power system.
4. Design and choose an appropriate Heating method for specific application and gain knowledge about electric Welding system**.**
5. Understand the concept of conservation of electrical energy.

TEXT BOOKS:

1. Uppal, S.L. and Rao, S., “Electrical Power Systems”, Khanna Publishers, 2009.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. Wadhwa, C.L., “Generation, Distribution and Utilization of Electrical Energy”, New Age International (P) Ltd, 2003.

REFERENCES:

1. Partab, H., “Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co, 2004.
2. Gupta, B.R., “Generation of Electrical Energy”, Eurasia Publishing House (P) Ltd, 2003.
3. Rai.G.D, “Non-conventional resources of energy”, Khanna publishers , Fourth edition , 2010.
4. Hamies, "Energy Auditing and Conservation; Methods, Measurements, Management & Case Study", Hemisphere, Washington, 1980.
5. Bureau & Energy Efficiency, "Energy Efficiency in Electrical Utilities", Guide Book for National Certification Examination for Energy Managers and Energy Auditors, New Delhi, 2013. (www.bee – india.nic.in)

U20EE704	PROJECT WORK PHASE-I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

To impart the practical knowledge to the students and also to make them to carry out the technical procedures in their project work. To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work and placing this as their beginning stage for their final presentation

METHODOLOGY:

- Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide
- Problem should be selected
- Students have to collect about 20 papers related to their work
- Report has to be prepared by the students as per the format
- Preliminary implementation can be done if possible
- Internal evaluation has to be done for 100 marks

TOTAL: 60 PERIODS

COURSE OUTCOMES:

- On Completion of the project work phase – I, students will be in a position to take up their final year project work and find solution by formulating proper methodology.

U20EE705 RENEWABLE ENERGY SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

Prerequisite: Basic knowledge of Engineering Physics and Chemistry

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. Simulation study on Hydel Power.
10. Experiment on Performance Assessment of 100W Fuel Cell.
11. Simulation study on Intelligent Controllers for Hybrid Systems.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand basics of Intelligent Controllers and analyze Renewable energy systems.
2. Train the students in Renewable Energy Sources and technologies.
3. Provide adequate inputs on a variety of issues in harnessing Renewable Energy.
4. Simulate the various Renewable energy sources.
5. Recognize current and possible future role of Renewable energy sources.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Personal computers (Intel i3, 80GB, 2GBRAM)	15	-
2.	CRO	9	30MHz
3.	Digital Multimeter	10	Digital
4.	PV panels - 100W, 24V	1	
5.	Battery storage system with charge and discharge control 40Ah	1	
6.	PV Emulator	1	
7.	Micro Wind Energy Generator module	1	

Consumabilitys (Minimum of 5 Nos. each)

8.	Potentiometer	5	-
9.	Step-down transformer	5	230V/12-012V
10	Component data sheets to be provided		

SEMESTER-VIII

		L	T	P	C
U20EE801	**PROJECT WORK PHASE-II**	**0**	**0**	**16**	**6**

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project report and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the head of the department.
- A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

METHODOLOGY:

- Three reviews have to be conducted by the committee of minimum of three members one of which should be the guide
- Each review has to be evaluated for 100 marks.
- Attendance is compulsory for all reviews. If a student fails to attend review for some valid reason, one or more chance may be given.
- They should publish the paper preferably in the journals/conferences.
- Final review will be done by the committee that consists of minimum of three members one of which should be the guide (if possible include one external expert examiner within the college).
- The report should be submitted by the students around at the end of May.

COURSE OUTCOMES

Learners are able to:

1. On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology
2. Apply the acquired technical knowledge and skills to solve real time problems
3. Design and fabricate food processing equipments
4. Formulate and develop value added food products
5. Apply scientific research tools for design and optimization of food processing operations.

PROFESSIONAL ELECTIVES (PE)

		L	T	P	C
U20EE611	**FLEXIBLE AC TRANSMISSION SYSTEMS**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge about power electronics and power system

COURSE OBJECTIVES:

- To knowledge the start-of-art of the power system
- To discuss the Performance of Compensator
- To analysis the modelling for Power Flow and stability studies
- To study about FACTS controllers for load flow analysis
- To discuss about FACTS controllers for dynamic analysis

UNIT I INTRODUCTION **9**

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Voltage control by SVC–Advantages of slope in dynamic characteristics–Influence of SVC on system voltage–Design of SVC voltage regulator–TCR-FC-TCR-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–Modelling of TCSC, Variability reactance model–Modelling 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- Dynamic voltage restorer (DVR).

UNIT V ADVANCED FACTS CONTROLLERS **9**

Interline DVR (IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Understand, analyze and develop analytical model of FACTS controller for power system application.
2. Understand the concepts about load compensation techniques.
3. Acquire knowledge on facts devices and advanced FACTS controllers.
4. Understand the start-of-art of the power system
5. Analyze the performance of steady state and transients of facts controllers.

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma, “Thyristor–Based Facts Controllers for Electrical Transmission Systems”, IEEE press andJohnWiley&Sons,Inc,2002.
2. NarainG. Hingorani, “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors,Delhi-110006,2011.
3. T.J.E Miller, Power Electronics in power systems, John Wiley and sons.

REFERENCES:

1. K.R. Padiyar, ”FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John, “Flexible A.C. Transmission Systems” ,Institution of Electrical and Electronic Engineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,Kluwer Academic Publishers,2004.

U20EE612	THERMAL AND FLUID ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: Knowledge about basic civil and mechanical engineering

COURSE OBJECTIVES:

- To impart knowledge about the concept of steam power generation
- To understand the working concept of internal combustion engine
- To impart knowledge about gas turbines and air compressors
- To introduce the basics of fluid mechanics
- To handle research level problems encountered in hydraulic pumps

UNIT – I STEAM POWER GENERATION 9

Properties of steam Steam power plant: Components of steam power plant – Rankine cycle – reheat cycle – calculation of efficiencies – Steam turbines: Impulse and reaction turbines – compounding of impulse turbines – condensers and cooling towers.

UNIT – II INTERNAL COMBUSTION ENGINE AND AIR CONDITIONING 9

Components of SI and CI engines – testing of IC engines – fuel feed systems – ignition systems – cooling system – lubricating system – governing of IC engines – Air Conditioning: psychometric properties of air – summer and winter air conditioning – automobile air conditioning systems.

UNIT – III GAS TURBINES AND AIR COMPRESSORS 9

Gas turbine power plant: Components, cycle of operation and classification – effect of reheating on cycle efficiency – Methods of heat recovery from the exhaust of gas turbine – Air Compressors: Reciprocating air compressor – influence of clearance volume and intercooling on the cycle efficiency – Rotary Compressors: Comparison of fan, blower and compressor – features of centrifugal compressor – working of vane compressor and roots blower.

UNIT – IV FLUID MECHANICS 9

Definition of fluid – viscosity – Newton’s Law of viscosity – Pressure and its measurement: simple manometers – Application of Bernoulli’s equation of flow measurement: venture meter, orifice meter and pitot tube – head loss due to friction in pipes – minor losses: sudden expansion, sudden contraction and bends - pipes in series, pipes in parallel.

UNIT – V HYDRAULIC MACHINERY 9

Turbines: Head and efficiencies associated with turbines – Classification of turbines – Pelton wheel: parts and working principle – Francis turbine: parts and working principle – Specific speed and its application. – unit quantities – governing of turbines. Pumps: Roto-dynamics and positive displacement pumps – centrifugal pumps: parts and working principles – priming – cavitation – Specific speed – Reciprocating pump: main parts and working principle – indicator diagram – effect of acceleration and friction on indicator diagram – use air vessel – Gear pump.

COURSE OUTCOMES:

Learners are able to

1. Design compressors and turbines
2. Understand the concept of steam power generation
3. Evaluate the performance characteristics of gas turbines
4. Understand the underlying concept of IC engines
5. Design the hydraulic applications for specific needs

TEXT BOOKS

1.Modi P N and Seth S M, Hydraulics and Fluid mechanics, Standard Publishing House, Delhi, 2007
2.Balaney P L, Thermal Engineering, Khanna Publishers, New Delhi, 2007

REFERENCE BOOKS

1.Rajput, RK. "Fluid Mechanics and Hydraulic Machines", S. Chand & Company, New Delhi, 2002.
2.Nag, P. K., “Engineering Thermodynamics”, 4th edition, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi,1995
3.Mathur M.L. and Sharma R.P **“**Internal Combustion Engines” *Dhanpat Rai &* Sons, New Delhi; 1992.

U20EE613	**MODERN CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

Prerequisite: Basic knowledge about engineering maths & control system

COURSE OBJECTIVES:

- To discuss the concepts of linear system design.
- To discuss the concepts of digital control systems.
- To understand the state variable representation of the system.
- To discuss the concept of state space design.
- To discuss the concepts optimal control theory.

UNIT I LINEAR SYSTEM DESIGN 9+3

Introduction- Design using Compensator – Realization of basic Compensators – Cascade Compensation in Time domain - Cascade Compensation in Frequency domain.

UNIT II DIGITAL CONTROL SYSTEMS 9+3

Introduction- Spectrum Analysis of Sampling Process-Signal Reconstruction – Difference Equations – Z Transform – Pulse Transfer Function- Inverse Z transform – Analysis of Sample data control systems using Z-transform - Z and S Domain Relationship- Stability Analysis of Sample Data control systems.

UNIT-III STATE SPACE MODELING AND ANALYSIS 9+3

Concept of state, State variable and State Model – State models for linear continuous and discrete time systems –Eigen values and Eigen vectors- Similarity transformation (Controllable, Observable and Diagonal Canonical forms)-State transition matrix-Solution of state homogenous and non-homogenous state equations.

UNIT-IV STATE SPACE DESIGN 9+3

Concepts of Controllability &Observability-Design of state feedback controllers - Pole placement technique- State Observers- Design of Full order and reduced order State Observer.

UNIT V OPTIMAL CONTROL SYSTEMS 9+3

Introduction – Parameter Optimization: Servo mechanisms - Optimal control problem: Transfer Function Approach, State Variable Approach – State Regulator Problem – Infinite-time Regulator Problem – Output Regulator and Tracking Problems – Parameter Optimization Regulators**.**

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Design different compensators and compensation schemes of linear systems.
2. Analyse and design digital systems
3. Modeling and analysis of systems in state space
4. Design systems in state space.
5. Design system based on performance index

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', 6th Edition, New Age International Publishers, 2017.
2. Katsuhiko Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2011.

REFERENCES:

1. Digital Control & State variable methods, M. Gopal , 3rd Edition, TMH ,2008
2. M. Gopal, 'Control Systems: Principles and Design',4th Edition, McGraw Hill Education, 2012.
3. John J. D'Azzo, Constantine H. Houpis and Stuart N. Sheldon, Linear Control System Analysis and
4. Design with Matlab, CRC Taylor & Francis, Reprint 2009.

U20EE614	**MICRO ELECTRO MECHANICAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Prerequisite: Basic knowledge about Engineering physics and chemistry

COURSE OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

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 – Inter digitised Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Applications – Magnetic Actuators Micro magnetic components – Case studies of MEMS in magnetic actuators.

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 , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic 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 – Striction and Antistriction methods – 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:

Learners are able to:

1. Understand the operation of micro devices and their applications.
2. Understand the operation of micro systems and their applications.
3. Understand the concept of sensors and actuators
4. Design the micro devices using the MEMS fabrication process.
5. Design the micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill,New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

U20EE615	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about Electrical machines

COURSE OBJECTIVES:

- Construction, principle of operation, control and performance of stepping motors.
- Construction, principle of operation, control and performance of switched reluctance motors.
- 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 and performance of other special Machines.

UNIT I STEPPER MOTORS 9

Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

UNIT II SWITCHED RELUCTANCE MOTORS (SRM) 9

Constructional features –Principle of operation- Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. 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 IV PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – 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

COURSE OUTCOMES:

Learners are able to:

1. Analyze and design controllers for special Electrical Machines.
2. Acquire the knowledge on construction and operation of stepper motor and switched reluctance motors.
3. Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
4. Acquire the knowledge on construction and operation of permanent magnet synchronous motors.
5. Select a special Machine for a particular application.

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984
3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T.J.E.Miller,'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R.Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

U20EE616 MICROCONTROLLER BASED SYSTEM DESIGN

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about microprocessor and microcontroller.

COURSE OBJECTIVES:

- To understand the concept of Architecture of PIC microcontroller
- To study about the Interrupts and timers
- To impart knowledge about Peripheral devices for data communication and transfer
- To study the Functional blocks of ARM processor
- To impart knowledge about Architecture of ARM processors

UNIT I INTRODUCTION TO PIC MICROCONTROLLER **9**

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–IC16cxx–- Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT II INTERRUPTS AND TIMER **9**

PIC micro controller Interrupts- External Interrupts-Interrupt Programming–Loop time subroutine Timers-Timer Programming– Front panel I/O-Soft Keys– State machines and key switches– Display of Constant and Variability strings.

UNIT III PERIPHERALS AND INTERFACING 9

I2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM— Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization -LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION 9

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution-ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the concepts of Architecture of PIC microcontroller
2. Acquire knowledge on Interrupts and timers.
3. Understand the importance of Peripheral devices for data communication.
4. understand the basics of sensor interfacing
5. Acquire knowledge in Architecture of ARM processors

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

REFERENCE:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.
2. Muhammad Ali Mazidi, "PIC Microcontroller and Embedded Systems", Pearson Education, 1st Edition, 2008.
3. John Iovine, "PIC Microcontroller Project Book", McGraw Hill 2000.
4. John Crisp, "Introduction to Microprocessors and Micro controllers", Elsevier, 2nd Edition, 2004.

U20EE617 MODERN POWER CONVERTERS

L	T	P	C
3	0	0	3

Prerequisite: **Basic knowledge about power electronics**

COURSE OBJECTIVES:

- To impart knowledge on Switched mode power supplies
- To enable the students to Study of AC-DC Converters
- To introduce the concept about Study of DC-AC Converters
- To understand the Concept of Matrix Converter
- To design and develop Soft switched techniques of converters

UNIT I SWITCHED MODE POWER SUPPLIES (SMPS) 9

DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

UNIT II AC-DC CONVERTERS 9

Switched mode AC-DC converters. synchronous rectification - single and three phase topologies - switching techniques - high input power factor . reduced input current harmonic distortion. improved efficiency. with and without input-output isolation. performance indices design examples.

UNIT III DC-AC CONVERTERS 9

Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.

UNIT IV AC-AC CONVERTERS WITH AND WITHOUT DC LINK 9

Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

UNIT V SOFT-SWITCHING POWER CONVERTERS 9

Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter. Resonant DC power supplies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Suggest converters for AC-DC conversion and SMPS
2. Understand the concepts of DC-AC conversion for inverters
3. Understand the concepts of AC-AC conversion for with DC link
4. Understand the concepts of AC-AC conversion for without DC link
5. Acquire knowledge on soft switching techniques

TEXT BOOKS:

1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.

REFERENCES:

1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004
2. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and Zhe Chen, Morgan & Claypool Publishers series, United States of America, 2006.
3. Krein Philip T, Elements of Power Electronics,Oxford University press, 2008
4. Agarwal ,Power Electronics: Converters, Applications, and Design, 3rd edition, Jai P, Prentice Hall,2000
5. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons, 2009.

U20GE635 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about professional ethics.

COURSE OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.
- To learn about copy Rights and trade Secrets in india
- To study about different Patent and Patent Amendment Act
- To acquire knowledge about Cyber Law and Digital Content Protection
- To understand the Infringement of IPRs and emerging issues

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOME:

Learners are able to:

1. Manage Intellectual Property portfolio to enhance the value of the firm.
2. Make use of copy Rights and trade Secrets in india
3. Apply appropriate techniques for different Patent and Patent Amendment Act
4. Illustrate the Cyber Law and Digital Content Protection
5. Choose appropriate Infringement of IPRs and emerging issues

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, “Intellectual Property Rights and Copy Rights, Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

U20EE721	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about measurements and instrumentation

COURSE OBJECTIVES:

- To describe about the various graphical programming techniques.
- Concept of Graphical Programming and Lab View
- To outline aspects and utilization of instrument interfaces
- PC based data acquisition
- To analysis the protocols used in network based automation.

UNIT I INTRODUCTION 9

Virtual Instrumentation: Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Virtual Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II GRAPHICAL PROGRAMMING AND Lab VIEW 9

Concepts of graphical programming – Lab VIEW software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays - Clusters. Local and global variables – String - Timers and dialog controls.

UNIT III MANAGING FILES & DESIGN PATTERNS 9

High-level and low -level file I/O functions available in Lab VIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – Stata machine programming – Communication between parallel loops – Understanding and avoiding race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT IV PC BASED DATA ACQUISITION 9

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT V DATA AQUISTION AND SIGNAL CONDITIONING 9

Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices - Image acquisition cards and Motion Controllers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the graphical programming techniques
2. Analyse and select proper instruments interface for a specific application.
3. Understand the protocols used in network based automation.
4. Design and Implement File I/O functions available in LabVIEW.
5. Do Calibration, Resolution for analog inputs and outputs

TEXT BOOKS:

1. Jeffrey Travis, Jim Kring, 'LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition), Prentice Hall, 2006
2. Sanjeev Gupta, ‘Virtual Instrumentation using LabVIEW’ TMH, 2004

REFERENCES:

1. Robert H. Bishop, ‘Learning with Lab-view’, Prentice Hall, 2003.
2. Kevin James, ‘PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control’, Newness, 2000.
3. Gary W. Johnson, Richard Jennings, ‘Lab-view Graphical Programming’, McGraw Hill Professional Publishing, 2001.

U20EE722	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about Engineering physics and measurements.

COURSE OBJECTIVES:

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages, Corona and its effects – Bewley lattice diagram- Protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Properties of Dielectric materials - 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 voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits – generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

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

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand Transients in power system.
2. Understand Generation and measurement of high voltage.
3. Understand High voltage testing and Measure over voltages.
4. Understand various types of over voltages in power system.
5. Test power apparatus and insulation coordination

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, ‘High Voltage Engineering’, Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, ‘High voltage Engineering fundamentals’, Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, ‘High voltage Engineering’, New Age International Publishers, Third Edition, 2010.

REFERENCES:
1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

U20EE723	CONTROL OF ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about machines and power electronics

COURSE OBJECTIVES:
- To understand the DC drive control.
- To study and analyze the Induction motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the SRM and BLDC motor drive control.
- To analyze and design the Digital control for drives.

UNIT I CONTROL OF DC DRIVES 9

Losses in electrical drive system, Energy efficient operation of drives, block diagram/ transfer function of self, separately excited DC motors --closed loop control-speed control- current control - constant torque/power operation - P, PI and PID controllers–response comparison.

UNIT II CONTROL OF INDUCTION MOTORDRIVE 9

VSI a n d C S I fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

UNIT III CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Open loop VSI fed drive and its characteristics–Self control–Torque control –Torque angle control –Power factor control–Brushless excitation systems—Field oriented control – Design of closed loop operation of Self control of Synchronous motor drive systems.

UNIT IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

UNIT V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to
1. Understand the control of DC drives
2. Understand the concepts voltage and frequency control
3. Acquire knowledge on control of synchronous motor drives.
4. Understand the control of SRM and BLDC motors
5. Analyze the phase locked loop and micro-computer control of DC drives.

TEXT BOOKS:

1. Dubey, G.K, Power semiconductor controlled devices, Prentice Hall International New jersey, 1989.
2. R.Krishnan,, Electric Motor Drives - Modeling, Analysis and Control Prentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors, Pergamon press, Oxford, 1988.

REFERENCES

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Buxbaum, A.Schierau, and K.Staughen, A design of control systems for DC drives, Springer-Verlag, Berlin, 1990.
3. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
4. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
5. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
6. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.

U20EE724 POWER QUALITY AND IMPROVEMENT TECHNIQUES

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about transmission and distribution

COURSE OBJECTIVES:

- To impart knowledge on Causes & Mitigation techniques of various PQ events.
- To understand the Various Active & Passive power filters.
- To sustain knowledge on Causes of Voltage and current distortions,
- To acquire the concept about Causes of harmonics in power system
- To introduce the Monitoring of various PQ events

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.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. 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 OVER VOLTAGES 9

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding – line arresters - protection of transformers and cables. 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

COURSE OUTCOMES:

Learners are able to:

1. Understand various sources, causes and effects of power quality issues,electrical systems and their measures and mitigation.
2. Study about the various Active & Passive power filters.
3. Understand the concepts about Voltage and current distortions, harmonics.
4. Acquire knowledge on compensation techniques.
5. Acquire knowledge on DVR.

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, “Electrical Power Systems Quality”, McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, “Power System Quality Assessment”, (New York Wiley),2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad,” Power Quality Problems & Mitigation Techniques” Wiley, 2015.

REFERENCES:

1. G.T. Heydt, “Electric Power Quality”, 2nd Edition. (West Lafayette, IN, Stars in a Circle Publication, 1994.
2. M.H.J Bollen, “Understanding Power Quality Problems: Voltage Sags and Interruptions”, (New York: IEEE Press), 2000.

U20EE725 ELECTRICAL SAFETY

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about fire and safety.

COURSE OBJECTIVES:

- To study the electrical safety rules, regulations and quality management by the power factor improvement.
- To understand the students about electrical installations
- To acquire the students about safety measures on electrical installations
- To impart knowledge about the maintain safety in hazardous areas
- To develop the electrical safety in distribution systems

UNIT I INDIAN ELECTRICITY RULES AND ACTS AND THEIR SIGNIFICANCE 9

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

UNIT II ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS 9

Wiring and 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 III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE **9**

Preliminary preparations – safe sequence – risk of plant and equipment – safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

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 ELECTRICAL SAFETY IN DISTRIBUTION SYSTEM **9**

Total quality control and management – Importance of high load factor – Disadvantages of low power factor – Causes of low P.F. – power factor improvement – equipments – Importance of P.F. improvement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the Indian electricity rules and their significance
2. Explain the safety standard in residential, commercial, and agricultural
3. Learn about electrical safety installation, testing and commission
4. Understand about flashovers and corona discharge
5. Understand about electrical safety in distribution system

TEXT BOOKS:

1. Rao, S. and Saluja, H.L., “Electrical Safety, Fire Safety Engineering and Safety Management”, Khanna Publishers, 1988.
2. Pradeep Chaturvedi, “Energy Management Policy, Planning and Utilization”, Concept Publishing Company, 1997.

REFERENCE BOOKS:

1. Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, 1998.
2. Gupta, B.R., “Power System Analysis and Design”, S.Chand and Sons, 2003.
3. Wadhwa, C.L., “Electric Power Systems”, New Age International, 2004

U20EE726 DESIGN OF POWER SUPPLIES

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about power electronics

COURSE OBJECTIVE:

- To impart knowledge on design of transformer
- To provide an in depth knowledge about modeling, analysis and Design of switched mode power converters.
- To analyze and design switch mode power electronic converters for various applications
- To understand the concept of soft switching converters
- To impart knowledge on current control converters.

UNIT I INTRODUCTION **9**

Reactive Elements in Power Electronic Systems - Design of inductor - Design of transformer - Capacitors for power electronic applications.

UNIT II SWITCHED MODE POWERCONVERTERS **9**

Switched Mode power converters : Buck Converter - Boost Converter - Buck-Boost Converter - Discontinuous Mode of Operation in dc to dc Converters - Isolated dc to dc Converters: Forward Converter - Push-Pull converter - Fly-back Converter.

UNIT III ANALYSIS OF CONVERTERS 9

Pulse Width Modulated Converter: Averaged Model of the Converter - Steady State Solution - Small Signal Model of The Converter - Transfer Functions of the converter - Generalized State Space Model of the Converter - Linear Small signal Model - Dynamic functions of the Converter.

UNIT IV SOFT SWITCHING CONVERTERS 9

Resonant Load Converters - Principle of Operation - SMPS Using Resonant Circuit - Steady State Modeling of Resonant SMPS - Resonant Switch Converters - Buck Converter with Zero Current Switching- Conversion Ratio of the Converter - Boost Converter with Zero Voltage Switching - Resonant Transition Phase Modulated Converters - Boost Converter with Zero Voltage Switching - Design considerations to achieve ZVS - Resonant Switching Converters with Active Clamp.- Analysis of Active Clamp ZVS Buck Converter – Steady State Conversion Ratio.

UNIT V CURRENT CONTROL OF CONVERTERS 9

Sub-harmonic Instability in Current Programmed Control - Determination of Duty Ratio for Current Programmed Control - Power Circuit of UPF Rectifiers - Average Current Mode Control - Resistor Emulator UPF Rectifiers.

COURSE OUTCOME:

Learners are able to:

1. Design of magnetic components (i.e., inductor and transformer) in a converter,
2. Analyze the Steady-state analysis of switched mode power supply
3. Obtain the Equivalent circuit Model for a switching power supply
4. Analyze the steady state Performance of soft switching converters
5. Describe the various current control switched mode power converter

TEXT BOOK:

1. Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2nd edition 2001.

REFERENCE BOOK:

1. S. S. Ang, A. Oliva, “Power Switching Converters”, Marcel Dekker, 2nd ed., 2005
2. H. W. Whittington, B. W. Flynn, D. E. Macpherson, “Switched Mode Power Supplies”, 2nd Ed., John Wiley & Sons Inc., 1997.
3. A. S. Kislovski, R. Redl, N. Sokal, “Dynamic Analysis of Switching-Mode DC/DC Converters”, Springer, 1994.

U20MG755	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about principles of management

COURSE OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.
- To understand the concept of teamwork and leadership skills
- To understand the concept of TQM tools
- To impart knowledge on quality function deployment
- To acquire knowledge on quality systems

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership – Partnering Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV QUALITY CONCEPTS 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards-AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction-ISO 14000 Series Standards-Concepts of ISO 14001-Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOME:

Learners are able to:

1. The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.
2. Know the principles of total quality management and peculiarities of their implementation
3. Develop in-depth knowledge on various tools and techniques of quality management
4. Learn the applications of quality tools and techniques in both manufacturing and service industry
5. Develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those

TEXT BOOK:

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

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
ISO9001-2015 standards

U20GE702 RESEARCH METHODOLOGY

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about Project Work

COURSE OBJECTIVES

- To impart knowledge on the basic research process.
- To provide knowledge on the different types of research.
- To educate the students on report writing.
- To impart knowledge on data collection and analysis
- To introduce the concept of research design and methods

UNIT I TYPES OF RESEARCH 9

Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical

UNIT II RESEARCH FORMULATION 9

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem -Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

UNIT III RESEARCH DESIGN AND METHODS 9

Research design – Basic Principles- Need of research design – Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis and Experimentation. Determining experimental and sample designs.

UNIT IV DATA COLLECTION AND ANALYSIS 9

Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods-Data Processing and Analysis strategies-Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

UNIT V REPORTING AND THESIS WRITING 9

Structure and components of scientific reports - Types of report – Technical reports and thesis – Significance –Different steps in the preparation – Layout, structure and Language of typical reports – Illustrations and tables - Bibliography, referencing and footnotes- Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Explain the basic research process.
2. Identify the research problems
3. Explain various design methods for formulating research problem
4. Depict the methods of data collection and processing
5. Write a technical report and a thesis.

TEXT BOOKS:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”, 2010.
2. Kothari, C.R., 1990. “Research Methodology: Methods and Techniques”. New Age International. 418p.

REFERENCES:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. “An introduction to Research Methodology”, RBSA Publishers.
2. Sinha, S.C. and Dhiman, A.K., 2002. “Research Methodology”, ESS Publications. 2 volumes.

U20EE831 VLSI DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To Study the fundamentals of CMOS circuits and its characteristics.
- To Learn the design and realization of combinational & sequential digital circuits.
- To design the Architectural choices and performance tradeoffs involved in designing and realizing the circuits in

  CMOS technology are discussed
- To Learn the different FPGA architectures and testability of VLSI circuits
- To design and implement testing methods

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Nonideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmmit Trigger, Monostability Sequential Circuits, Astability Sequential Circuits. Timing Issues : Timing Classification Of Digital System, Synchronous Design**.**

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Realize the concepts of digital building blocks using MOS transistor.
2. Design combinational MOS circuits and power strategies.
3. Design and construct Sequential Circuits and Timing systems.
4. Design arithmetic building blocks and memory subsystems.
5. Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson , 2017.(UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits:A Design perspective”, Second Edition , Pearson , 2016.(UNIT III,IV)

REFERENCES

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits: Analysis & Design”, 4th edition McGraw Hill Education,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

U20EE832	ENERGY MANAGEMENT AND AUDIT	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about power system and energy resources.

COURSE OBJECTIVES:

- To impart knowledge on automation systems
- To provide idea on demand side management
- To understand the concept of customer side energy management
- To develop the students on energy audit concepts
- To assess and analyse the energy auditing

UNIT I PRINCIPLE OF ENERGY MANAGEMENT AND DISTRIBUTION AUTOMATION 9

Introduction – Need Based Energy Management (NBEM) – advantages – conversional distribution network – automated system – Distribution Automation System (DAS) – communication interface – PLCC – different data communication systems – distribution SCADA – distribution automation – load management in automated distribution system – RTU – substation automation – feeder automation – consumer side automation

UNIT II DEMAND SIDE MANAGEMENT 9

Introduction – scope of demand side management (DSM) – evolution of DSM concepts – DSM planning and implementation – load management as DSM strategy – application of load control – end use of energy conversion – tariff options for DSM – customer acceptance – implementation issues – implementation strategies – DSM environment – international experience with DSM.

UNIT III CONSUMER SIDE ENERGY MANAGEMENT 9

Industrial heating – resistance heating, induction heating, arc heating, dielectric and micro wave heating – Radiant heating – cost of electrical energy – lighting – lamp life time – efficient lighting – motive power and power factor improvement – capacitor rating– effects of power factor improvement – temperature measurement – optimum start control – efficient use of electrical energy in air conditioning –high efficiency motors –Motor drives and controls – other factors in motor system efficiency – Utility rebates for motor and drives.

UNIT IV ENERGY AUDIT 9

Basic principles of energy audit – definition of energy auditing – objectives – energy flow diagram – strategy of energy audit – comparison with standards – energy management team – considerations in implementing energy with conservation programmes – periodic progress review– energy audit concept – reduced line loss – power quality – differed capital expenses – energy cost reduction – optimal energy use – improved reliability.

UNIT V ENERGY AUDIT OF ELECTRICAL SYSTEMS 9

Instruments for energy audit – energy audit of heating, ventilation and air conditioning systems – energy audit of compressed air systems – energy audit of buildings – energy audit of steam generation, distribution and utilization systems – energy audit of electric drive utilities – economic analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand the basics on Distribution Automation.
2. Acquires knowledge about Demand side management and their implementation issues.
3. Understand in Demand side management problems
4. Understand the concept of Energy Audit
5. Understand and acquire knowledge about Energy Audit of Electrical Systems.

TEXT BOOKS:

1. Gupta B.R., 'Generation of Electrical Energy', S.Chand & Co. Ltd, New Delhi, 2001.
2. Rai G.D, 'Non Conventional Energy Sources', Khanna Publishers, New Delhi, 2000.

REFERENCES:

1. Murphy W.R, McKay G., "Energy Management", Butterworths Publications, London,1982.
2. Trivedi P.R., Jolka B.R., "Energy Management", Common Wealth Publishers, New Delhi, 1997.
3. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006.

		L	T	P	C
U20EE833	**DISTRIBUTED GENERATION AND MICRO GRID**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge about generation, transmission and distribution.

COURSE OBJECTIVES

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration
- To understand the concept of energy storage elements
- To design methods to control microgrids.

UNIT I INTRODUCTION 9

Conventional power generation: advantages and disadvantages, Energy crises, Nonconventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II DISTRIBUTED GENERATIONS (DG) 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

UNIT III IMPACT OF GRID INTEGRATION 9

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

UNIT IV BASICS OF A MICROGRID 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids,

UNIT V CONTROL AND OPERATION OF MICROGRID 9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

1. Understand the energy harvesting from solar and wind energy systems
2. Understand the concepts of microgrids
3. Acquire knowledge on impacts of grid integration
4. Understand the control methods of grid
5. Analyze the performance microgrid

TEXT BOOKS:

1. Voltage Source Converters in Power Systems: Modeling, Control and Applications", Amirnaser Yezdani, and Reza Iravani, IEEE John Wiley Publications.
2. "Renewable Energy Resources" John Twidell and Tony Weir, Tyalor and Francis Publications, Second Edition.

REFERENCES:

1. Power Switching Converters: Medium and High Power", DorinNeacsu, CRC Press, Taylor & Francis, 2006.
2. "Solar Photo Voltaics", Chetan Singh Solanki, PHI learning Pvt. Ltd., New Delhi,2009
3. "Wind Energy Explained, theory design and applications," J.F. Manwell, J.G. McGowan Wiley publication
4. "Biomass Regenerable Energy", D. D. Hall and R. P. Grover, John Wiley, New York, 1987.

U20EE834 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about power electronics and energy resources

COURSE OBJECTIVES:

- To Provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9

Stand- alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand and analyze power system operation, stability, control and protection.
2. Handle the engineering aspects of electrical energy generation and utilization.
3. Acquire knowledge on power converters
4. Analysis of solar and wind power systems
5. Design and develop hybrid renewable energy systems

TEXT BOOK:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi, 2009.

REFERENCES:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley India Pvt. Ltd, 2012.

U20EE835 ELECTRIC VEHICLES AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about power electronics and vehicles

COURSE OBJECTIVES

- To Provide knowledge about the Electric and Hybrid Electric Vehicles.
- To Provide knowledge about the Energy Storage in Fuel Cells
- To analyse and comprehend the various types of Electric Propulsion
- To design the Electric and Hybrids Electric Vehicles
- To know the knowledge of Power Electronic Converter in Battery Charging.

UNIT I ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains

UNIT II ENERGY STORAGE FOR EV AND HEV 9

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modelling of PEMFC, SuperCapacitors

UNIT III ELECTRIC PROPULSION 9

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

UNIT IV DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES 9

Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design

UNIT V POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING 9

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High-frequency transformer based isolated charger topology, Transformer less topology

COURSE OUTCOMES:

Learners are able to:

1. Understand and analyze power system operation, stability, control and protection.
2. Handle the engineering aspects of electrical energy generation and utilization.
3. Develop the electric and hybrid vehicles
4. Design the power electronic converter
5. Understand the concept of electric propulsion

TEXT BOOKS:

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2005
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003

REFERENCES:

1. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
2. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press, 2001.
3. Chris Mi, M. Abul Masrur, David Wenzhong Gao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2011.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
5. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.
6. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.

U20EE836	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about batteries and Engineering chemistry

COURSE OBJECTIVE:

- To enable the student to understand the need for energy storage, devices and technologies available and their applications
- To understand the concept of batteries
- To impart knowledge on energy storage of various applications
- To acquire knowledge on electrical energy storage
- To design energy storage for various applications

UNIT I INTRODUCTION 9

Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT II ELECTROCHEMICAL ENERGY STORAGE SYSTEMS BATTERIES 9

Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Lead Lead acid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes in electrodes.

UNIT III NEEDS FOR ELECTRICAL ENERGY STORAGE 9

Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy

UNIT IV ENERGY STORAGE 9

Need of energy storage; Different modes of Energy Storage. Potential energy: Pumped hydro storage; KE and Compressed gas system: Flywheel storage, compressed air energy storage; Electrical and magnetic energy storage: Capacitors, electromagnets; Chemical Energy storage: Thermo-chemical, photo-chemical, bio-chemical, electro-chemical, fossil fuels and synthetic fuels. Hydrogen for energy storage. Solar Ponds for energy storage

UNIT V DESIGN AND APPLICATIONS OF ENERGY STORAGE 9

Renewable energy storage-Battery sizing and stand-alone applications, stationary (Power Grid application), Small scale application-Portable storage systems and medical devices, Mobile storage Applications- Electric vehicles (EVs), types of EVs, batteries and fuel cells, future technologies, hybrid systems for energy storage.

COURSE OUTCOMES:

Learners are able to:

1. Analyze the characteristics of energy from various sources and need for storage
2. Classify various types of energy storage and various devices used for the purpose
3. Identify various real time applications.
4. Know the concept of energy storage system
5. Analyse and performance of cell technologies

TEXT BOOKS:

1. James M. Eyer, Joseph J. Iannucci and Garth P. Corey “, “Energy Storage Benefits and Marke Analysis”, Sandia National Laboratories, 2004.

REFERENCES:

1. Ibrahim Dincer and Mark A Rosen, “Thermal Energy Storage Systems and Applications”, John Wiley and Sons 2011.
2. James Larminie and Andrew Dicks, “Fuel cell systems Explained”, Wiley Publications, 2003.
3. Ru-shiliu, Leizhang, Xueliang sun, “Electrochemical technologies for energy storage and conversion”, Wiley Publications, 2012.
4. Yves Brunet., “Energy storage”, Wiley publications,2013.
5. Luisa F.Cabeza.,Advances in thermal energy storage systems, Woodhead publications 2014.
6. Advances in Thermal Energy Storage Systems - Methods and Applications, A volume in Woodhead Publishing Series in Energy Book, 2015
7. Nihal Kularatna “Energy Storage Devices for Electronic Systems”, 1st Edition, Academic Press 2015.

		L	T	P	C
U20EE837	**POWER SYSTEM RESTRUCTURING AND PRICING**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge about transmission and distribution

COURSE OBJECTIVE:

- To impart knowledge on fundamentals of power markets
- To understand the technical challenges on powermarkets
- To impart knowledge on system security services
- To acquire knowledge on market pricing
- To impart knowledge about indian market

UNIT I: FUNDAMENTALS AND ARCHITECTURE OF POWER MARKETS 9

Deregulation of Electric utilities: Introduction-Unbundling-Wheeling- Reform motivations-Fundamentals of Deregulated Markets – Types (Future, Day-ahead and Spot) – Participating in Markets (Consumer and Producer Perspective) – bilateral markets – pool markets. Independent System Operator (ISO)-components-types of ISO - role of ISO - Lessons and Operating Experiences of Deregulated Electricity Markets in various Countries (UK, Australia, Europe, US, Asia).

UNIT II: TECHNICAL CHALLENGES 9

Total Transfer Capability – Limitations - Margins – Available transfer capability (ATC) – Procedure - Methods to compute ATC – Static and Dynamic ATC – Effect of contingency analysis – Case study. Concept of Congestion Management – Bid, Zonal and Node Congestion Principles – Inter and Intra zonal congestion – Generation Rescheduling - Transmission congestion contracts – Case Study.

UNIT III: TRANSMISSION NETWORKS AND SYSTEM SECURITY SERVICES 9

Transmission expansion in the New Environment – Introduction – Role of transmission planning – Physical Transmission Rights – Limitations – Flow gate - Financial Transmission Rights – Losses – Managing Transmission Risks – Hedging – Investment. Ancillary Services – Introduction – Describing Needs – Compulsory and Demand-side provision – Buying and Selling Ancillary Services – Standards.

UNIT IV: MARKET PRICING 9

Transmission pricing in open access system – Introduction – Spot Pricing – Uniform Pricing – Zonal Pricing – Locational Marginal Pricing – Congestion Pricing – Ramping and Opportunity Costs. Embedded cost based transmission pricing methods (Postage stamp, Contract path and MWmile)– Incremental cost based transmission pricing methods (Short run marginal cost, Long run marginal cost) - Pricing of Losses on Lines and Nodes.

UNIT V: INDIAN POWER MARKET 9

Current Scenario – Regions – Restructuring Choices – Statewise Operating Strategies - Salient features of Indian Electricity Act 2003 – Transmission System Operator – Regulatory and Policy development in Indian power Sector – Opportunities for IPP and Capacity Power Producer. Availability based tariff – Necessity – Working Mechanism – Beneficiaries – Day Scheduling Process – Deviation from Schedule – Unscheduled Interchange Rate – System Marginal Rate – Trading Surplus Generation – Applications.

COURSE OUTCOMES:

Learners are able to:

1. Know the fundamentals of power markets.
2. Know the technical challenges of power markets.
3. Analyse and performance of system security services.
4. Know the concept of market pricing.
5. Analyse the Indian power market in state wise.

TEXT BOOKS:

1. S. A. Khaparde and A. R. Abhyankar, “Restructured Power Systems”, Narosa Publishing House, New Delhi, India, 2008.
2. S. C. Srivastava and S. N. Singh, “Operation and Management of Power system in Electricity Market”, Narosa Publishing House, New Delhi, India, 2008.

REFERENCES:

1. Kankar Bhattacharya, Math H.J. Bollen and Jaap E. Daalder, “Operation of Restructured Power Systems”, Kluwer Academic Publishers, 2001.
2. Loi Lei Lai, “Power system Restructuring and Regulation”, John Wiley sons, 2001.
3. M. Shahidehpour and M. Alomoush, “Restructuring Electrical Power Systems”, Marcel Decker Inc., Scholarly Transaction Papers and Utility web sites, 2001.

U20GE801	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

Pre-requisites: Basic knowledge of ethical problems and Principles

COURSE OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instil Moral and Social Values and Loyalty and to appreciate the rights of others.
- To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
- To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.
- To have an adequate knowledge about MNC’s, Business, Environmental, Computer Ethics, Honesty, Moral Leadership, sample Code of Conduct.

UNIT I HUMAN VALUE **9**

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 **9**

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 **9**

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

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

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 **9**

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: 45 PERIODS

COURSE OUTCOMES:
Learners are able to:

1. The student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.
2. The students will understand the basic perception of profession, professional ethics, various moral & social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
3. The students will aware of professional rights and responsibilities of an engineer, responsibilitie an engineer for safety and risk benefit analysis.
4. The students will acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.
5. Understand the role of professional bodies

TEXT BOOKS:

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

REFERENCES:

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. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” McGraw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ‘Value Education’, Vethathiri publications, Erode,2011.

WEB RESOURCES

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

U20EE841 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about transmission and distribution

COURSE OBJECTIVES:

- To introduce concept on Planning of DC power transmission and comparison with AC power transmission.
- To impart knowledge on HVDC converters.
- To make students to understand HVDC system control.
- To know the concept Harmonics and design of filters.
- To identify Power flow in HVDC system under steady state.

UNIT I INTRODUCTION 9

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC – Types and applications of MTDC systems.

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– Generation of harmonics –Design of AC and DC filters– Active 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

COURSE OUTCOMES:

Learners are able to:

1. Understand the principles and types of HVDC system.
1. Analyze and understand the concepts of HVDC converters.
2. Understand the concepts of reactive power management, harmonics and power flow analysis
3. Get knowledge about Planning of DC power transmission and comparison with AC power transmission.
4. Understand the importance of power flow in HVDC system under steady state.

TEXT BOOKS:

1. Padiyar,K.R.,"HVDC power transmission system", New Age International(P)Ltd. NewDelhi, Second Edition,2010.
2. Arrillaga,J.,"High Voltage Direct Current Transmission", Peter Pregrinus, London,1983.

REFERENCES:

1. Kundur P.," Power System Stability and Control", McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG,"High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Edward Wilson Kimbark," Direct Current Transmission", Vol.I, Wiley inter science, New York, London, Sydney,1971.

U20EE842	REACTIVE POWER MANAGEMENT	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge about Transmission Systems and Power Electronics

COURSE OBJECTIVES:

- To impart knowledge on the basic of reactive power control
- To provide knowledge on the different types compensation methods.
- To know the knowledge reactive power components
- To understand the concept of reactive power management
- To impart knowledge about compensators

UNIT I INTRODUCTION **9**

Introduction, Importance of reactive power control in EPS, Reactive power devices. Theory of Load Compensation: Introduction- Requirement for compensation, Objectives in load compensation, Specifications of a load compensator, Power factor correction and voltage regulations in single phase system, Phase balancing and p. f. correction of unsymmetrical loads, Compensation in term of symmetrical components.

UNIT II REACTIVE POWER CONTROL **9**

Reactive Power Control: Fudamental requirement in AC Power transmission, Fundamental transmission line equation, Surge impedance and natural loading, Voltage and current profiles of uncompensated radial and symmetrical line on open circuit, Uncompensated line under load, Effect of line length, Load power and p. f on voltage and reactive power. Passive and active compensators, Uniformly distributed fixed compensation, Passive shunt compensation, Control of open circuit voltage by shunt reactance, Reactance of shunt reactors, multiple shunt reactors along the line.

UNIT III SERIES COMPENSATION **9**

Series compensation: Objectives and practical limitations, Symmetrical line with mid-point series capacitor and shunt reactor, Power transfer characteristics and maximum transmissible power for a general case, Fundamental concepts of compensation by sectioning.

UNIT IV STATIC COMPENSATION **9**

Principles of Static Compensation: Principle of operation of thyristor controlled reactor, Thyristors switched capacitor. Series Capacitors: Introduction, protective gear, reinsertion schemes, Varistor protective gear.Synchronous Condenser: Introduction, Power system Voltage control, Emergency reactive power supply, Starting methods, starting motor, reduced voltage starting, static starting.

UNIT V REATIVE POWER COMPONENTS **9**

Harmonics effects, resonance, shunt capacitors and filters, telephone interferences, Reactive Power Co-ordination, Reactive power management, transmission benefits, reactive power dispatch & equipment impact.

COURSE OUTCOMES:

Learners are able to:

1. Understand the concept of reactive power control in power system.
2. Analyze and understand the various types of reactive power components.
3. Assess the various compensation methods in real time environment
4. Invoke knowledge about compensating devices
5. Understand the concept of reactive power management

TEXT BOOKS:

1. Reactive power control in electric power systems, T. J. E. Miller, John Wiley & Sons NY 2009
2. Reactive Power Management, D. Tagare, TMH, 1st Edition,2004.

REFERENCES:

1. Power System Stability and Control,P. Kundur, TMH, 9th reprint, 2007.
2. Power System Voltage Stability, Carson. W. Taylor, McGraw-Hill, Inc.

U20EE843 TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENTS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge about Electrical Machines and Protection and Switchgear

COURSE OBJECTIVES:

- To provide the concept of installation of transformer
- To provide knowledge on test on synchronous motors
- To impart knowledge about test on induction motor
- To assess and analyze tests for electrical machines
- To impart knowledge protective devices

UNIT I TRANSFORMERS 9

Specifications: Power and distribution transformers as per BIS standards.**Installation:** 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.**Commissioning tests:** Following tests as per national & International Standards, 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.**Specific Tests:** Determination of performance curves like efficiency, regulation etc, and determination of mechanical stress under normal &abnormal conditions.

UNIT II SYNCHRONOUS MACHINES 9

Specifications: As per BIS standards. **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, measurements of sequence impedances, capacitive reactance, and separation of losses, temperature rise test, and retardation tests. **Factory tests:** Gap length, magnetic eccentricity, balancing vibrations, bearing performance.

UNIT III INDUCTION MOTORS 9

Specifications for different types of motors, Duty, I.P. protection **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.

UNIT IV ELECTRICAL TESTS 9

Insulation test, earth resistance, high voltage test, starting up, failure to speed up to take the load, type of test, routine test, factory test and site test (in accordance with ISI code**Specific Tests:** Performance & temperature raise tests, stray load losses, shaft alignment, and re-rating & special duty capability.

Unit-V SWITCH GEAR & PROTECTIVE DEVICES 9

Standards, types, specification, installation, commissioning tests, maintenance schedule, type & routine tests.

COURSE OUTCOMES:

Learners are able to:

1. Know the concept of installation of transformers
2. Understand the installation of synchronous machines
3. Assess different tests on electrical machines
4. Invoke knowledge on induction motors
5. Understand the usage of protective devices

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.

REFERENCES:

1. Relevant Bureau of Indian Standards
2. A Handbook on Operation and Maintenance of Transformers- H. N. S. Gowda, Published by H. N. S. Gowda,2006
3. Handbook of SwitchGears, BHEL, TMH,2005
4 J and P Transformer Book, Elsevier Publication.

U20EE844	ELECTRIC VEHICLE CHARGING TECHNOLOGIES	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge of Renewable Energy Systems and power plant Engineering

COURSE OBJECTIVES:

- To understand the concept of electrical vehicles and its operations
- To understand the need for charging methods in hybrid vehicles
- To provide knowledge about various possible charging technologies that can be used in electric vehicles
- To design electrical system design for Electrical vehicles
- To understand the concept of solar energy harvesting for EV charging

UNIT I INTRODUCTION - ELECTRIC VEHICLE 9

History, Components of Electric Vehicle, Comparison with Internal combustion Engine: Technology, EV classification and their electrification levels, EV Terminology

UNIT II TYPES OF EV CHARGERS 9

Electric Vehicle Technology and Charging Equipment's, Basic charging Block Diagram of Charger, Difference between Slow charger and fast charger, Slow charger design rating, Fast charger design rating, AC charging and DC charging, Type of Mode of charger Mode -2 , Mode-3 and Mode-4

UNIT III SELECTION AND SIZING OF FAST AND SLOW CHARGER (AC & DC) 9

AC Pile Charger, DC Pile Charger, EVSE Power Module selection and technical specification, Selection of Electric Vehicle Supply Equipment (EVSE) Communication Protocol (PLC / Ethernet / Modbus/ CAN, Module), Communication gateway, Specification of open charge point protocol (OCCP 1.6/2.0), Bharat DC001 & AC001 Charger specification, Selection of AC charger type-1 , type -2 and type -3, Communication between AC charger and EV, IS/IEC/ARAI/ standard of Charging topology, Communication and connectors (IEC 61851-1, IEC 61851-24,62196-2)

UNIT IV PUBLIC CHARGING INFRASTRUCTURE / ELECTRICAL SYSTEM DESIGN 9

Assessment of site Location for Public charging station, Selection and Sizing of Distribution transformer, Selection and sizing of HT Equipment (VCB, CT, PT, Metering), Selection and Sizing HT Cables and LT cables, Selection and sizing of Distribution Board / feeders, Sizing calculation of LT and HT cable, Selection and of Compact Substation (CSS for EV CS)/ Power Substation), Selection of relay and calculation

UNIT V EV CHARGER INTEGRATION WITH SOLAR POWER PLANT 9

Selection of PV module technology, Types of solar inverter, Selection of string /central / off grid inverter, Selection of power conditioning unit (PCU), Sizing of solar inverter for roof top and grid connected projects, Selection and sizing of inverter, Protection requirement of solar inverter Earthing Layout/ AC /DC cabling Layout

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Identify the importance of hybrid electric vehicle
2. Explicate the different train topologies and power flow control in electric vehicles
3. Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources
4. Choose proper energy storage systems for vehicle applications
5. Identify the different Energy storage for Electric Vehicle.

TEXT BOOKS:

1. Editors: Veneri, Ottorino “Technologies and Applications for Smart Charging of Electric and Plug- in Hybrid Vehicles”: Springer, 2017
2. Larminie, James, and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012.

REFERENCES:

1. Ryan Collin, Yu Miao , Alex Yokochi , Prasad Enjeti and Annette von Jouanne “Advanced Electric Vehicle Fast-Charging Technologies” , Energies 2019, 12(10), 1839; https://doi.org/10.3390/en12101839, (This article belongs to the Special Issue Power Processing Systems for Electric Vehicles).
2. Hussain Shareef, Md. MainulIslam, Azah Mohamed “A review of the stage-of-the-art charging technologies, placement methodologies, and impacts of electric vehicles”, Elsevier - Renewable and Sustainable Energy Reviews, Volume 64, October 2016, Pages 403-420.
3. Emadi, A. (Ed.), Miller, J., Ehsani, M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003.
4. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.

		L	T	P	C
U20EE845	**ELECTRICAL WIRING ESTIMATION AND COSTING**	**3**	**0**	**0**	**3**

Prerequisite: Basic knowledge of distribution systems

COURSE OBJECTIVES:

- To enable the students to prepare the schedule of materials with specifications and estimates for different types of electrical installations.
- To introduce the usage of service mains and its installations
- To impart knowledge on lighting installations
- To design circuits for power installations
- To analysis and assess the distribution power lines

UNIT I INTRODUCTION 9

Meaning of estimation, purpose of estimating and the factors to be considered while preparing estimations, qualities of a good estimator, Meaning of specification, importance of specification and the factors to be considered. Meaning of standardization and its advantages. Meaning of overhead charges, stock incidental charges, contingencies, supervision charges, labour charges, Inspection/Inspectorate charges, transportation charges and miscellaneous charges. Meaning of tender/tender notice, quotation, comparative statement, purchase order and work order. Importance / purpose of IE Act and IE Rules. Meaning of earthing, touch potential and step potential, necessity of earthing, Points to be earthed, factors influencing earth resistance, methods of reducing earth resistance, standard values of earth resistance for various installations, method of selecting the size of earth conductor, types /methods of earthing, Pipe earthing-diagram, specifications of pipe earthing, Plate earthing-diagram and specifications of plate earthing.

UNIT II SERVICE MAINS 9

Meaning of service mains, code of Practice for service mains, types of service mains- Over Head Service Mains -materials and specifications, UG Service Mains -materials and specifications, Standard wire size table, current ratings for Aluminium, copper conductors and selection of size of conduit pipe as per the size and number of wires. Load calculation, selection of size and type of conductor/UG cable, discrimination of size of protective devices, Quantity calculation, schedules of materials and estimates for single phase OH service connection, three phase OH service connection, single phase UG service connection and three phase UG service connection.

UNIT III LIGHTING INSTALLATIONS 9

For complete syllabus and results, class timetable and more. light weight, easy to use, no images, no pdfs platform to make students life easier.

UNIT IV POWER INSTALLATIONS 9

Code of Practice for Power Installations, materials required for power circuit wiring and their specifications, Prepare the layout diagram of machines showing clearances as per IS standards, draw wiring plan of the Power circuit for workshops, Decide the type of wiring system, load calculations, determine the size of conductors, main switch, Isolators, sub switches and protective devices, Draw the SLD of Power Distribution Scheme showing grading/discrimination of ratings of protective devices, Prepare the schedule of materials with specifications for workshops and their estimates, Determine the rating of motor for IP set and the concept (only)of pump house wiring.

UNIT V DISTRIBUTION LINES AND TRANSFORMER CENTRE 9

Code of practice for Distribution Lines and Transformer centre, types of transformer centres -Pole mounted, plinth mounted, indoor and outdoor types. Determining the rating of Distribution Transformer. Write Specifications of the Distribution Transformer. Draw the SLD of a Transformer centre indicating the size of protective devices, Prepare the schedule of equipments /Materials with specifications for a 11KV/415V,100 KVA transformer centre and their estimates, 415 V LT line materials and specifications , method of calculating various LT line materials (only). Prepare the schedule of materials (only) for 3 phase 4 wire LT line, 11 KV HT Line-materials and their specifications, method of calculating various HT line materials and tapping structure, TOPO sheet and its use, Concept of combined estimates. Prepare the schedule of materials (only) for 11 KV single circuit HT line for Rural Electrification. (Note: HT lines over head type only)

COURSE OUTCOMES:

Learners are able to:

1. Understand the concept of electrical installations
2. Design circuits for power installations
3. Design circuits for lighting installations
4. Acquires knowledge on power distributions
5. Understand the concept of servicemains

TEXT BOOKS:

1. N.Alagappan and Ekambaram “Electrical Estimating and Costing”: Tata McGraw Hill, New Delhi,2004.
2. K.B.Raina&K.Battacharya., “Electrical Design Estimating and Costing” New Age International ,2019.

REFERENCE:

1. Electrical Design Estimating and Costing. K.B.Raina&K.Battacharya. Khanna Publications.
2. Electrical Installation Estimating and Costing. J.B.Gupta S.K.Kataria and Sons
3. Electrical Wiring, Estimating and Costing. Dr.S.L.Uppal New age international limited
4. Electrical Estimating and costing. Surjit Singh DhanpatRai company.
5. Electrical Estimating and Costing. N.Alagappan and Ekambaram Tata McGraw Hill
6. Electrical wiring, Estimating and costing B.D.Arora R.B. Publication.
7. Electrical Estimating Specification and Costing M. RaghunathRao Eastern Book Promoters Belgaum
8. pls download iStudy Syllabus App.

U20EE846	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

Prerequisite: NIL

COURSE OBJECTIVES:

- To familiarize with soft computing concepts.
- To introduce the ideas of neural networks, fuzzy logic and use of heuristics based on human experience.
- To introduce the concepts of Genetic algorithm and its applications to soft computing
- To design fuzzy logic for real time applications
- To understand the concept of evolutionary algorithm

UNIT I ARTIFICIAL NEURAL NETWORKS 9

Motivation for the development of neural networks- biological neural networks- artificial neural networks – Fundamental Concepts - weights - biases and thresholds - common activation functions. McCulloch-Pitts neuron: Architecture, algorithm - Hebb Net- Architecture - algorithm - Perceptron – Architecture- algorithm- applications- Linear separability.

UNIT II NEURAL NETWORK ARCHITECTURE AND ALGORITHMS 9

Backpropagation Neural Network: Architecture - algorithm - Discrete Hopfield neural net- architecture - algorithm – Kohonen self-organizing Maps – Adaptive Resonance Theory- Basic architecture - Algorithm.

UNIT III FUZZY LOGIC 9

Introduction to Fuzzy Logic-- Classical sets – Operations, Properties on classical set- Fuzzy sets – Operations, Properties on Fuzzy set –Classical relation - Fuzzy relations –Tolerance and Equivalence Relations-Non interactive Fuzzy set.

UNIT IV FUZZY LOGIC CONTROL SYSTEM 9

Architecture and operation of a FLC system -system models- Fuzzification - Membership value assignments using intuition - Membership functions- Defuzzification: Max-Membership principle - centroid method - weighted average method - Inference Engine – Applications of FLC

UNIT V EVOLUTIONARY ALGORITHM 9

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Genetic Algorithm – encoding and decoding of variables – GA operators – reproductions – Cross over – mutation – fitness function –fitness scaling-applications of GA –PSO: Basics, Global Best PSO, Local Best PSO, gbest versus lbest PSO, Velocity Components, Geometric Illustration, Algorithm Aspects - Ant Colony, SA – Hybrid varieties.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand basic neural network architecture and perform linear separability.
2. Apply suitable activation functions for the various neural networks.
3. Understand various neural network architectures and algorithms
4. Acquires knowledge on Fuzzy Logic Control System and use it for real time applications
5. Gain knowledge about genetic algorithm and Particle swarm optimization and use them in optimizing real time applications.

TEXT BOOKS:

1. Ross T.J,"Fuzzy Logic with Engineering Applications",Mc Graw-Hill,Newyork,2005.
2. Kosko,B. "Neural Networks And Fuzzy Systems", Prentice-Hall of India Pvt. Ltd., 1994.

REFERENCES:

1. Andries P. Engelbrecht," Computational Intelligence: An Introduction", John Wiley & Sons Ltd., Second Edition, 2007.
2. S.N Sivanandam,S.N.Deepa "Principles of Soft computing", Wiley India Pvt.Ltd, 2010.
3. S.Rajashekaran, G.A.Vijayalakshmipai, "Neural networks, Fuzzy logic and Genetic Algorithms-synthesis and applications." Prentice-Hall of India Pvt. Ltd., Reprint 2010.

U20EE847 DIAGNOSIS AND PROTECTION FOR SOLID STATE SYSTEMS

L	T	P	C
3	0	0	3

Prerequisite: Basic knowledge of solid state devices

COURSE OBJECTIVES:

- To understand the protection of converter systems
- To familiarize the concept of protection devices in solid state AC devices
- To impart the concept of protection devices in solid state DC devices
- To introduce the idea of excitation systems
- To analysis the fault systems

UNIT-I PROTECTION AND FAULT DIAGNOSIS OF CONVERTER SYSTEMS 9

Protections to SCR based power conversion systems: devices, converters ñ naturally commutated converters ñ single and three phase converters ñ dual converters ñ cyclo-converters - higher pulse converters ñ forced commutated choppers/inverters. Fault diagnosis of converters: device failures - commutation failures ñ phase failures; Fault diagnosis of control loops: failure of controller and limiters, sensor and reference, starting and braking.

UNIT-II PROTECTION AND DIAGNOSIS OF SOLID STATE DEVICES IN POWER SYSTEMS 9

Protections to solid state compensators/voltage regulator ñ TCR, TCS, SVC, TCSC, UPFC, solid state tap changer; Fault diagnosis through waveform/performance analysis of device failures, phase failures, sensor failures; Protection and fault diagnosis of filter ññ aging of passive components and detuning ñ auto tuning methods.

UNIT-III PROTECTION AND FAULT DIAGNOSIS OF SOLID STATE DC DRIVES 9

Protections to solid state DC drives ñ field failures, armature failures, commutator short/open, operations with converter/chopper failures ñ device, input source, filter component failures. Closed loop control failures ñ failure of controllers and limiters, sensor and references. Diagnosis of solid state dc drive systems faults - starting and braking.

UNIT-IV PROTECTION AND DIAGNOSIS OF SOLID STATE AC DRIVES 9

Protection to AC Machines - phase failures, slip-ring/brush failures, bearing failures; Effects of solid state converter/inverter systems failures of device, PWM modulators, input source, filter components - voltage/current ripple effects, closed loop failures: failure of controller ñ sensor - references. Diagnosis of solid state ac drive systems faults.

UNIT-V PROTECTION AND DIAGNOSIS OF HVDC, UPS AND EXCITATION SYSTEMS 9

Protection and faults in HVDC, UPS, Generator excitation systems: individual systems, multiple systems operating in parallel/series ñ redundancy - diagnosis of faults through characterization. Analysis of simple faults in complex solid state systems.

COURSE OUTCOMES:

Learners are able to:

1. Understand physiology systems of human body, the bio-medical transducers.
2. Understand the concepts of biomedical electrodes, amplifiers, and different lead systems
3. Analyze the non-electrical parameter measurements of blood and cardiac system.
4. Understand different medical imaging techniques
5. Understand the functions of various therapeutic biomedical assisting equipment's.

TEXT BOOKS :

1. Power Electronics, Mohan, Underland and Robbins, John Wiley &Sons, 1995.
2. Pulse Width Modulation for Power Converters: Principles and Practice, D. Grahame Holmes, Thomas A. Lipo, Wiley-IEEE Press, Year.
3. Self-Commutating Converters for High Power Applications, Jos Arrillaga, Yonghe H. Liu, Neville R. Watson, Nicholas J. Murray, John Wiley & Sons, 2009.
4. Modern Power Electronics and AC Drives, Bimal K.Bose, Pearson Education (Singapore) Ltd., New Delhi, 2003.
5. Facts Controllers in Power Transmission and Distribution, K.R.Padiyar, New Age International (P) Limited, New Delhi, 2007.

REFERENCES:

1. Introduction to Modern Power Electronics, Andrzej M. Trzynadlowski, John Wiley & Sons, 2010.
2. Thyristor-Based FACTS Controllers for Electrical Transmission Systems, R. Mohan and R.K.Varma, IEEE Press ñ A John Wiley and Sons, Inc. Publications. Year.
3. High-Power Converters and AC Drives, Bin Wu, Wiley-IEEE Press. Curriculum and Syllabus for Post Graduate Programmes (CBCS) July 2011 M.Tech in EEE, Electrical Drives and Control Syllabi - 16/30
4. HVDC and FACTS Controller: Application of Static Converters in power systems, Vijay K. Sood, IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, 2004.
5. Vector Control of Three-Phase AC Machines: System Development in the Practice, Nguyen Phung Quang, Jˆrg-Andreas Dittrich, Springer, 2008.

U20EE848 BIO MEDICAL INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts involved in biomedical instrumentation and measuring techniques.
- To understand the concepts of diagnostic procedures
- To impart the knowledge on electrical parameter acquistions
- To knowledge students on imaging modalities
- To design life assisting and robotic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems –Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system – Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to:

1. Understand physiology systems of human body, the bio-medical transducers.
2. Understand the concepts of biomedical electrodes, amplifiers, and different lead systems
3. Analyze the non-electrical parameter measurements of blood and cardiac system.
4. Understand different medical imaging techniques
5. Understand the functions of various the rapeutic biomedical assisting equipment’s.

TEXT BOOKS:

1. R.S.Khandpur, ‘Hand Book of Bio-Medical instrumentation’, Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, ‘Bio-Medical Instrumentation and Measurements’, II edition, Pearson Education, 2002 / PHI.

REFERENCES:

1. M.Arumugam, ‘Bio-Medical Instrumentation’, Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, ‘Principles of Applied Bio-Medical Instrumentation’,John Wiley & Sons, 1975.
3. J.Webster, ‘Medical Instrumentation’, John Wiley & Sons, 1995.