JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE-R19

COURSE STRUCTURE AND SYLLABUS

For

B. TECH ELECTRICAL AND ELECTRONICS ENGINEERING

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

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I Year – I SEMESTER

Sl. No	Course Code	Subjects	L	T	P	Credits
1	HS1101	English	3	0	0	3
2	BS1101	Mathematics - I	3	0	0	3
3	BS1106	Applied Chemistry	3	0	0	3
4	ES1101	Programming for Problem Solving Using C	3	0	0	3
5	ES1103	Engineering Drawing	1	0	3	2.5
6	HS1102	English Lab	0	0	3	1.5
7	BS1107	Applied Chemistry Lab	0	0	3	1.5
8	ES1102	Programming for Problem Solving Using C Lab	0	0	3	1.5
9	MC1101	Environmental Science	3	0	0	0
		Total Credits	**16**	**0**	**12**	**19**

I Year – II SEMESTER

Sl. No	Course Code	Subjects	L	T	P	Credits
1	BS1202	Mathematics – II	3	0	0	3
2	BS1203	Mathematics – III	3	0	0	3
3	BS1204	Applied Physics	3	0	0	3
4	ES1212	Fundamentals of Computers	3	0	0	3
5	ES1217	Electrical Circuit Analysis - I	3	0	0	3
6	ES1218	Electrical Engineering Workshop	0	0	3	1.5
7	BS1205	Applied Physics Lab	0	0	3	1.5
8	HS1203	Communication Skills Lab	0	1	2	2
9	PR1201	Engineering Exploration Project	0	0	2	1
		Total Credits	**15**	**1**	**10**	**21**

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II Year – I SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Electrical Circuit Analysis - II	EE	3	--	--	3
2		Electrical Machines-I	EE	3	--	--	3
3		Electronic Devices and Circuits	ES	3	--	--	3
4		Electro Magnetic Fields	EE	3	--	--	3
5		Thermal and Hydro Prime movers	ES	3	--	--	3
6		Managerial Economics & Financial Analysis	BS	3	--	--	3
7		Thermal and Hydro Laboratory	ES	--	--	3	1.5
8		Electrical Circuits Laboratory	EE	--	--	3	1.5
9		Essence of Indian Traditional Knowledge	MC	3	--	--	0
		Total Credits		**24**	**0**	**6**	**21**

II Year – II SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Electrical Measurements & Instrumentation	EE	3	--	--	3
2		Electrical Machines-II	EE	3	--	--	3
3		Digital Electronics	ES	3	--	--	3
4		Control Systems	EE	3	--	--	3
5		Power Systems-I	EE	3	--	--	3
6		Signals and Systems	EE	3	--	--	3
7		Electrical Machines -I Laboratory	EE	--	--	3	1.5
8		Electronic Devices & Circuits Laboratory	EE	--	--	3	1.5
9		Professional Ethics and Human Values	MC	3	0	0	0
		Total Credits		**21**	**0**	**6**	**21**

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III Year – I SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Power Systems-II	EE	3	--	--	3
2		Power Electronics	EE	3	--	--	3
3		Linear IC Applications	ES	3	--	--	3
4		Digital Signal Processing	EE	3	--	--	3
5		Microprocessors and Microcontrollers	EE	3	--	--	3
6		Electrical Machines-II Laboratory	EE	--	--	3	1.5
7		Control Systems Laboratory	EE	--	--	2	1
8		Electrical Measurements & Instrumentation Laboratory	EE	--	--	3	1.5
9		Socially Relevant Projects	MC	--	--	1	1
		Total Credits		**15**	**0**	**9**	**20**

III Year – II SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Electric Drives	EE	3	--	--	3
2		Power System Analysis	EE	3	--	--	3
3		Data Structures	ES	3	--	--	3
4		Digital Control Systems	EE	3	--	--	3
5		**Elective - I**	EL	3	--	--	3
6		**Open Elective - I**	OE	3	--	--	3
7		Power Electronics Laboratory	EE	--	--	3	1.5
8		Microprocessors & Microcontrollers Laboratory	EE	--	--	3	1.5
9		Employability Skills	MC	3	--	--	0
		Total Credits		**18**		**6**	**21**

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IV Year – I SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Switchgear & Protection	EE	3	--	--	3
2		OOPs through JAVA	ES	3	--	--	3
3		Renewable Energy Systems	EE	3	--	--	3
4		**Elective – II**	EL	3	--	--	3
5		**Elective - III**	EL	3	--	--	3
6		Linear & Digital IC Applications Laboratory	ES	--	--	2	1
7		Power Systems& Simulation Laboratory	EE	--	--	2	1
		Industrial Training /Skill Development Programmes / Research Project	Project	--	--	2	1
8		Project-I	Project			4	2
		Total Credits		**15**	**0**	**10**	**20**

IV Year – II SEMESTER

S. No	Course Code	Subjects	Category	L	T	P	Credits
1		Power System Operation & Control	EE	3	--	--	3
2		**Open Elective - II**	OE	3	--	--	3
3		**Elective - IV**	EL	3	--	--	3
4		Project-II	Project	--	--	16	8
		Total Credits		**09**		**16**	**17**

BS – Basic Sciences   **EE – Electrical Engineering**
HS – Humanity Sciences   **OE – Open Elective   Proj- Project**
ES – Engineering Sciences   **EL – Elective   MC–Mandatory Course**

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Elective – I:

1. Digital IC Applications
2. Communication Systems
3. Computer Networks
4. Internet of Things applications to Electrical Engineering
5. VLSI Design
6. Cloud Computing

Elective – II:

1. Utilization of Electrical Energy
2. Data Base Management System
3. Advanced Control Systems
4. Electrical Machine Design
5. Hybrid Electric Vehicles
6. Swayam Course

Elective – III:

1. Operating Systems
2. Neural Networks &Fuzzy Logic
3. High Voltage Engineering
4. Energy Auditing and Demand Side Management
5. Data Analytics with Python
6. Swayam Course

Elective – IV:

1. Electrical Distribution Systems
2. HVAC & DC Transmission
3. Flexible Alternating Current Transmission Systems
4. Power Quality
5. Smart Grid
6. Special Electrical Machines

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Open Electives offered by EEE Department for Other Branches(Except for EEE Branch)

Open Elective-I:

1. Renewable Energy Sources
2. Essentials of Analog and Digital Electronics
3. Electrical Estimation and Costing
4. Power Electronic Devices & Circuits
5. Fundamentals of Electrical Machines

Open Elective-II:

1. Measurements & Instrumentation
2. Fundamentals of Utilization of Electrical Energy
3. Concepts of Power System Engineering
4. Basics of Control Systems
5. Energy Audit

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I Year - I Semester		L	T	P	C
		3	0	0	3
	ENGLISH (HS1101)				

Introduction

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent and integrated approach that improves the learners' ability to effectively use English language in academic/ workplace contexts. The shift is from *learning about the language* to *using the language*. On successful completion of the compulsory English language course/s in B.Tech., learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity based teaching-learning methods would be adopted to ensure that learners would engage in actual use of language both in the classroom and laboratory sessions.

Course Objectives

- ➢ Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- ➢ Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- ➢ Help improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations
- ➢ Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- ➢ Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

Learning Outcomes

At the end of the module, the learners will be able to
- ➢ understand social or transactional dialogues spoken by native speakers of English and identify the context, topic, and pieces of specific information
- ➢ ask and answer general questions on familiar topics and introduce oneself/others
- ➢ employ suitable strategies for skimming and scanning to get the general idea of a text and locate specific information
- ➢ recognize paragraph structure and be able to match beginnings/endings/headings with paragraphs
- ➢ form sentences using proper grammatical structures and correct word forms

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Unit 1:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications
Lesson-2: Deliverance by Premchand from "**The Individual Society",** Pearson Publications.
    (Non-detailed)
Listening: Listening to short audio texts and identifying the topic. Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions both in speaking and writing.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests. Self introductions and introducing others.

Reading: Skimming text to get the main idea. Scanning to look for specific pieces of information.

Reading for Writing: Paragraph writing (specific topics) using suitable cohesive devices; linkers, sign posts and transition signals; mechanics of writing - punctuation, capital letters.

Vocabulary: Technical vocabulary from across technical branches (20) GRE Vocabulary (20) (Antonyms and Synonyms, Word applications) Verbal reasoning and sequencing of words.

Grammar: Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countables and uncountables; singular and plural basic sentence structures; simple question form - wh-questions; word order in sentences.
Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

Lesson-1: Nehru's letter to his daughter Indira on her birthday from "**Infotech English**", Maruthi Publications

Lesson-2: Bosom Friend by Hira Bansode from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts, both in speaking and writing.

Speaking: Discussion in pairs/ small groups on specific topics followed by short structured talks. Functional English: Greetings and leave takings.

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Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary Analogies (20 words) (Antonyms and Synonyms, Word applications)

Grammar: Use of articles and zero article; prepositions.

Pronunciation: Past tense markers, word stress-di-syllabic words

Unit 3:

Lesson-1: Stephen Hawking-Positivity 'Benchmark' from "**Infotech English**", Maruthi Publications

Lesson-2: Shakespeare's Sister by Virginia Woolf from "**The Individual Society",** Pearson Publications. (Non-detailed**)**

Listening: Listening for global comprehension and summarizing what is listened to, both in speaking and writing.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Functional English: Complaining and Apologizing.

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension. Critical reading.

Reading for Writing: Summarizing - identifying main idea/s and rephrasing what is read; avoiding redundancies and repetitions. Letter writing-types, format and principles of letter writing. E-mail etiquette, Writing CV's.

Vocabulary: Technical vocabulary from across technical branches (20 words). GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Association, sequencing of words

Grammar: Verbs - tenses; subject-verb agreement; direct and indirect speech, reporting verbs for academic purposes.

Pronunciation: word stress-poly-syllabic words

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Unit 4:

Lesson-1: Liking a Tree, Unbowed: Wangari Maathai-biography from "**Infotech English**", Maruthi Publications

Lesson-2: Telephone Conversation-Wole Soyinka from "**The Individual Society",** Pearson Publications**.** (Non-detailed)

Listening: Making predictions while listening to conversations/ transactional dialogues without video (only audio); listening to audio-visual texts.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions. Functional English: Permissions, Requesting, Inviting.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicative process or display complicated data.

Reading for Writing: Information transfer; describe, compare, contrast, identify significance/trends based on information provided in figures/charts/graphs/tables. Writing SOP, writing for media.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Cloze Encounters.

Grammar: Quantifying expressions - adjectives and adverbs; comparing and contrasting; degrees of comparison; use of antonyms

Pronunciation: Contrastive Stress

Unit 5:

Lesson-1: Stay Hungry-Stay foolish from "**Infotech English**", Maruthi Publications

Lesson-2: Still I Rise by Maya Angelou from "**The Individual Society",** Pearson Publications. (Non-detailed)

Listening: Identifying key terms, understanding concepts and interpreting the concepts both in speaking and writing.

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Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides. Functional English: Suggesting/Opinion giving.

Reading: Reading for comprehension. RAP Strategy Intensive reading and Extensive reading techniques.

Reading for Writing: Writing academic proposals- writing research articles: format and style.

Vocabulary: Technical vocabulary from across technical branches (20 words) GRE Vocabulary (20 words) (Antonyms and Synonyms, Word applications) Coherence, matching emotions.

Grammar: Editing short texts – identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Pronunciation: Stress in compound words

Prescribed text books for theory:
   1. "**Infotech English**", Maruthi Publications. (Detailed)
   2. "**The Individual Society",** Pearson Publications. (Non-detailed)

Reference books:
   1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
   2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT;
      2nd Edition, 2018.
   3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
   4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

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I Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
	MATHEMATICS-I (BS1101) **(Common to all Branch's for I Year B. Tech)**				

Course Objectives:

- This course will illuminate the students in the concepts of calculus.

- To enlighten the learners in the concept of differential equations and multivariable calculus.

- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

- utilize mean value theorems to real life problems (L3)

- solve the differential equations related to various engineering fields (L3)

- familiarize with functions of several variables which is useful in optimization (L3)

- Apply double integration techniques in evaluating areas bounded by region (L3)

- students will also learn important tools of calculus in higher dimensions. Students will become familiar with 2- dimensional and 3-dimensional coordinate systems (L5)

UNIT I: Sequences, Series and Mean value theorems: **(10 hrs)**

Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

Mean Value Theorems (without proofs): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's theorems with remainders.

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UNIT II: Differential equations of first order and first degree: (10 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form.
Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal trajectories – Electrical circuits.

UNIT III: Linear differential equations of higher order: (10 hrs)

Non-homogeneous equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} $V(x)$ and $x^n V(x)$ – Method of Variation of parameters.
Applications: LCR circuit, Simple Harmonic motion.

UNIT IV: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT V: Multiple integrals: (8 hrs)

Double and Triple integrals – Change of order of integration – Change of variables.
Applications: Finding Areas and Volumes.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:
1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
3. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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I Year - I Semester		L	T	P	C
		3	0	0	3
	APPLIED CHEMISTRY (BS1106)				

Knowledge of basic concepts of Chemistry for Engineering students will help them as professional engineers later in design and material selection, as well as utilizing the available resources.

Learning Objectives:

- *Importance* of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
- *Outline* the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
- *Express* the increase in demand as wide variety of advanced materials are introduced; which have excellent engineering properties.
- *Explain* the crystal structures, and the preparation of semiconductors. Magnetic properties are also studied.
- *Recall* the increase in demand for power and hence alternative sources of power are studied due to depleting sources of fossil fuels. Advanced instrumental techniques are introduced.

UNIT I POLYMER TECHNOLOGY

Polymerisation:- Introduction-methods of polymerization (emulsion and suspension)-physical and mechanical properties.

Plastics: Compounding-fabrication (compression, injection, blown film, extrusion) - preparation, properties and applications of PVC, polycarbonates and Bakelite-mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste.

Elastomers:- Natural rubber-drawbacks-vulcanization-preparation, properties and applications of synthetic rubbers (Buna S, thiokol and polyurethanes).

Composite materials: Fiber reinforced plastics-conducting polymers-biodegradable polymers-biopolymers-biomedical polymers.

Learning Outcomes: *At the end of this unit, the students will be able to*

- *Outline* the properties of polymers and various additives added and different methods of forming plastic materials.
- *Explain* the preparation, properties and applications of some plastic materials.
- *Interpret* the mechanism of conduction in conducting polymers .
- *Discuss* natural and synthetic rubbers and their applications.

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION

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Single electrode potential-Electrochemical series and uses of series-standard hydrogen electrode, calomel electrode-concentration cell-construction of glass electrode-Batteries: Dry cell, Ni-Cd cells, Ni-Metal hydride cells, Li ion battery, zinc air cells–Fuel cells: H_2-O_2, CH_3OH-O_2, phosphoric acid, molten carbonate.

Corrosion:-Definition-theories of corrosion (chemical and electrochemical)-galvanic corrosion, differential aeration corrosion, stress corrosion, waterline corrosion-passivity of metals-galvanic series-factors influencing rate of corrosion-corrosion control (proper designing, cathodic protection)-Protective coatings: Surface preparation, cathodic and anodic coatings, electroplating, electroless plating (nickel). Paints (constituents, functions, special paints).

Learning Outcomes: *At the end of this unit, the students will be able to*
- ***Explain*** the theory of construction of battery and fuel cells.
- ***Categorize*** the reasons for corrosion and study some methods of corrosion control.

UNIT III: MATERIAL CHEMISTRY

Part I *: **Non-elemental semiconducting materials***:- Stoichiometric, controlled valency & chalcogen photo/semiconductors-preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion, ion implantation) - Semiconductor devices (p-n junction diode as rectifier, junction transistor).

Insulators & magnetic materials: electrical insulators-ferro and ferri magnetism-Hall effect and its applications.

Part II:

Nano materials:- Introduction-sol-gel method- characterization by BET, SEM and TEM methods-applications of graphene-carbon nanotubes and fullerenes: Types, preparation and applications

Liquid crystals:- Introduction-types-applications.

Super conductors:-Type –I, Type II-characteristics and applications

Learning Outcomes: *At the end of this unit, the students will be able to*

- ***Understand*** the importance of materials like nanomaterials and fullerenes and their uses.
- ***Understand*** liquid crystals and superconductors.
- ***Understand*** the preparation of semiconductors.

UNIT IV: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY

Computational chemistry: Introduction, Ab Initio studies

Molecular switches: characteristics of molecular motors and machines, Rotaxanes and Catenanes as artificial molecular machines, prototypes – linear motions in rotaxanes, an acid-base controlled molecular shuttle, a molecular elevator, an autonomous light-powered molecular motor

Learning Outcomes: *At the end of this unit, the students will be able to*
- ***Obtain*** the knowledge of computational chemistry
- ***Understand*** importance molecular machines

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UNIT V: SPECTROSCOPIC TECHNIQUES & NON CONVENTIONAL ENERGY SOURCES

Part A: **SPECTROSCOPIC TECHNIQUES**

Electromagnetic spectrum-UV (laws of absorption, instrumentation, theory of electronic spectroscopy, Frank-condon principle, chromophores and auxochromes, intensity shifts, applications), FT-IR (instrumentation and IR of some organic compounds, applications)- magnetic resonance imaging and CT scan (procedure & applications).

Part B*: NON CONVENTIONAL ENERGY SOURCES**

Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

Learning Outcomes: *At the end of this unit, the students will be able to*

- understand the principles of different analytical instruments.
- explain the different applications of analytical instruments.
- design sources of energy by different natural sources.

Standard Books:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co.

Reference Books:

1. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 edition.

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I Year - I Semester		L	T	P	C
		3	0	0	3
PROGRAMMING FOR PROBLEM SOLVING USING C (ES1101)					

COURSE OBJECTIVES:
The objectives of Programming for Problem Solving Using C are
1) To learn about the computer systems, computing environments, developing of a computer program and Structure of a C Program
2) To gain knowledge of the operators, selection, control statements and repetition in C
3) To learn about the design concepts of arrays, strings, enumerated structure and union types. To learn about their usage.
4) To assimilate about pointers, dynamic memory allocation and know the significance of Preprocessor.
5) To assimilate about File I/O and significance of functions

UNIT I
Introduction to Computers: Creating and running Programs, Computer Numbering System, Storing Integers, Storing Real Numbers
Introduction to the C Language: Background, C Programs, Identifiers, Types, Variable, Constants, Input/output, Programming Examples, Scope, Storage Classes and Type Qualifiers.
Structure of a C Program: Expressions Precedence and Associativity, Side Effects, Evaluating Expressions, Type Conversion Statements, Simple Programs, Command Line Arguments.

UNIT II
Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators.
Selection & Making Decisions: Logical Data and Operators, Two Way Selection, Multiway Selection, More Standard Functions
Repetition: Concept of Loop, Pretest and Post-test Loops, Initialization and Updating, Event and Counter Controlled Loops, Loops in C, Other Statements Related to Looping, Looping Applications, Programming Examples

UNIT III
Arrays: Concepts, Using Array in C, Array Application, Two Dimensional Arrays, Multidimensional Arrays, Programming Example – Calculate Averages
Strings: String Concepts, C String, String Input / Output Functions, Arrays of Strings, String Manipulation Functions String/ Data Conversion, A Programming Example – Morse Code
Enumerated, Structure, and Union: The Type Definition (Type def), Enumerated Types, Structure, Unions, and Programming Application

UNIT IV

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COURSE STRUCTURE-R19

Pointers: Introduction, Pointers to pointers, Compatibility, L value and R value
Pointer Applications: Arrays, and Pointers, Pointer Arithmetic and Arrays, Memory Allocation Function, Array of Pointers, Programming Application
Processor Commands: Processor Commands

UNIT V
Functions: Designing, Structured Programs, Function in C, User Defined Functions, Inter-Function Communication, Standard Functions, Passing Array to Functions, Passing Pointers to Functions, Recursion
Text Input / Output: Files, Streams, Standard Library Input / Output Functions, Formatting Input / Output Functions, Character Input / Output Functions
Binary Input / Output: Text versus Binary Streams, Standard Library, Functions for Files, Converting File Type.

TEXT BOOKS:

1. Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg, CENGAGE
2. The C Programming Language, Brian W.Kernighan, Dennis M. Ritchie, 2e, Pearson

REFERENCES:

1. Computer Fundamentals and Programming, Sumithabha Das, Mc Graw Hill
2. Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson
3. Computer Fundamentals and Programming in C, Pradip Dey, Manas Ghosh, OXFORD

COURSE OUTCOMES:

Upon the completion of the course the student will learn
1) To write algorithms and to draw flowcharts for solving problems
2) To convert flowcharts/algorithms to C Programs, compile and debug programs
3) To use different operators, data types and write programs that use two-way/ multi-way selection
4) To select the best loop construct for a given problem
5) To design and implement programs to analyze the different pointer applications
6) To decompose a problem into functions and to develop modular reusable code
7) To apply File I/O operations

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COURSE STRUCTURE-R19

I Year - I Semester		L	T	P	C
		1	0	3	2.5
	ENGINEERING DRAWING (ES1103)				

Course Objective: Engineering drawing being the principal method of communication for engineers, the objective is to introduce the students, the techniques of constructing the various types of polygons, curves and scales. The objective is also to visualize and represent the 3D objects in 2D planes with proper dimensioning, scaling etc.

Unit I

Objective: To introduce the students to use drawing instruments and to draw polygons, Engg. Curves.

Polygons: Constructing regular polygons by general methods, inscribing and describing polygons on circles.

Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, involutes, tangents & normals for the curves.

Scales: Plain scales, diagonal scales and vernier scales

Unit II

Objective: To introduce the students to use orthographic projections, projections of points & simple lines. To make the students draw the projections of the lines inclined to both the planes.

Orthographic Projections: Reference plane, importance of reference lines, projections of points in various quadrants, projections of lines, line parallel to both the planes, line parallel to one plane and inclined to other plane.

Projections of straight lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

Unit III

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes.

Projections of planes: regular planes perpendicular/parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes.

Unit IV

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the planes.

Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

Unit V

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Objective: The objective is to represent the object in 3D view through isometric views. The student will be able to represent and convert the isometric view to orthographic view and vice versa.

Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer Aided Design, Drawing practice using Auto CAD, Creating 2D&3D drawings of objects using Auto CAD

Note: In the End Examination there will be no question from CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications
2. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

REFERENCE BOOKS:

1. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
2. Engineering Graphics for Degree by K.C. John, PHI Publishers
3. Engineering Graphics by PI Varghese, McGrawHill Publishers
4. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

Course Outcome: The student will learn how to visualize 2D & 3D objects.

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COURSE STRUCTURE-R19

I Year - I Semester		L	T	P	C
		0	0	3	1.5
	ENGLISH LAB (HS1102)				

UNIT I:
Vowels, Consonants, Pronunciation, Phonetic Transcription

UNIT II:

Past tense markers, word stress-di-syllabic words, Poly-Syllabic words

UNIT III:

Rhythm & Intonation

UNIT IV:

Contrastive Stress (Homographs)

UNIT V:

Word Stress: Weak and Strong forms
Stress in compound words

References books:

1. Infotech English, Maruthi Publications (with Compact Disc).
2. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
3. English Pronunciation in use- Mark Hancock, Cambridge University Press.
4. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
5.   English Pronunciation in use- Mark Hewings, Cambridge University Press.
6. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
7. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

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COURSE STRUCTURE-R19

I Year - I Semester		L	T	P	C
		0	0	3	1.5
APPLIED CHEMISTRY LAB (BS1107)					

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions,

volumetric titrations, quantitative analysis

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of a sample containing Na_2CO_3 and NaOH.
3. Determination of Mn (II) using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of copper (II) using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of iron (III) by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of the concentration of strong acid vs strong base (by conductometric method).
10. Determination of strong acid vs strong base (by potentiometric method).
11. Determination of Mg^{+2} present in an antacid.
12. Determination of $CaCO_3$ present in an egg shell.
13. Estimation of Vitamin C.
14. Determination of phosphoric content in soft drinks.
15. Adsorption of acetic acid by charcoal.
16. Preparation of nylon-6, 6 and Bakelite (demonstration only).

Of the above experiments at-least 10 assessment experiments should be completed in a semester.

Outcomes: The students entering into the professional course have practically very little exposure to lab classes. The experiments introduce volumetric analysis; redox titrations with different indicators; EDTA titrations; then they are exposed to a few instrumental methods of chemical analysis. Thus at the end of the lab course, the student is exposed to different methods of chemical analysis and use of some commonly employed instruments. They thus acquire some experimental skills.

Reference Books
1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

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COURSE STRUCTURE-R19

I Year - I Semester		L	T	P	C
		0	0	3	1.5
PROGRAMMING FOR PROBLEM SOLVING USING C LAB (ES1202)					

Course Objectives:

1) Apply the principles of C language in problem solving.
2) To design flowcharts, algorithms and knowing how to debug programs.
3) To design & develop of C programs using arrays, strings pointers & functions.
4) To review the file operations, preprocessor commands.

Exercise 1:
1. Write a C program to print a block F using hash (#), where the F has a height of six characters and width of five and four characters.
2. Write a C program to compute the perimeter and area of a rectangle with a height of 7 inches and width of 5 inches.
3. Write a C program to display multiple variables.

Exercise 2:
1. Write a C program to calculate the distance between the two points.
2. Write a C program that accepts 4 integers p, q, r, s from the user where r and s are positive and p is even. If q is greater than r and s is greater than p and if the sum of r and s is greater than the sum of p and q print "Correct values", otherwise print "Wrong values".

Exercise 3:
1. Write a C program to convert a string to a long integer.
2. Write a program in C which is a Menu-Driven Program to compute the area of the various geometrical shape.
3. Write a C program to calculate the factorial of a given number.

Exercise 4:
1. Write a program in C to display the n terms of even natural number and their sum.
2. Write a program in C to display the n terms of harmonic series and their sum. $1 + 1/2 + 1/3 + 1/4 + 1/5 \dots 1/n$ terms.
3. Write a C program to check whether a given number is an Armstrong number or not.

Exercise 5:
1. Write a program in C to print all unique elements in an array.
2. Write a program in C to separate odd and even integers in separate arrays.
3. Write a program in C to sort elements of array in ascending order.

Exercise 6:
1. Write a program in C for multiplication of two square Matrices.
2. Write a program in C to find transpose of a given matrix.

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Exercise 7:
1. Write a program in C to search an element in a row wise and column wise sorted matrix.
2. Write a program in C to print individual characters of string in reverse order.

Exercise 8:
1. Write a program in C to compare two strings without using string library functions.
2. Write a program in C to copy one string to another string.

Exercise 9:
1. Write a C Program to Store Information Using Structures with Dynamically Memory Allocation
2. Write a program in C to demonstrate how to handle the pointers in the program.

Exercise 10:
1. Write a program in C to demonstrate the use of & (address of) and *(value at address) operator.
2. Write a program in C to add two numbers using pointers.

Exercise 11:
1. Write a program in C to add numbers using call by reference.
2. Write a program in C to find the largest element using Dynamic Memory Allocation.

Exercise 12:
1. Write a program in C to swap elements using call by reference.
2. Write a program in C to count the number of vowels and consonants in a string using a pointer.

Exercise 13:
1. Write a program in C to show how a function returning pointer.
2. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc( ) function.

Exercise 14:
1. Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc( ) function. Understand the difference between the above two programs
2. Write a program in C to convert decimal number to binary number using the function.

Exercise 15:
1. Write a program in C to check whether a number is a prime number or not using the function.
2. Write a program in C to get the largest element of an array using the function.

Exercise 16:
1. Write a program in C to append multiple lines at the end of a text file.
2. Write a program in C to copy a file in another name.
3. Write a program in C to remove a file from the disk.

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COURSE STRUCTURE-R19

Course Outcomes:

By the end of the Lab, the student

1) Gains Knowledge on various concepts of a C language.
2) Able to draw flowcharts and write algorithms.
3) Able design and development of C problem solving skills.
4) Able to design and develop modular programming skills.
5) Able to trace and debug a program

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I Year - I Semester		L	T	P	C
		3	0	0	0
	ENVIRONMENTAL SCIENCE (MC1101)				

Learning Objectives:
The objectives of the course are to impart:
- Overall understanding of the natural resources.
- Basic understanding of the ecosystem and its diversity.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
- An understanding of the environmental impact of developmental activities.
- Awareness on the social issues, environmental legislation and global treaties.

UNIT-I:
Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects;. Role of information technology in environment and human health.
Ecosystems: Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.

UNIT-II:
Natural Resources: Natural resources and associated problems.
Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people.
Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.
Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.
Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.
Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources.
Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

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UNIT-III:
Biodiversity and its conservation: Definition: genetic, species and ecosystem diversity-classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

UNIT – IV Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being.
Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.
UNIT – V Social Issues and the Environment: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act - Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.
Environmental Management: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics.
The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.

Text Books:
1. Environmental Studies, K. V. S. G. Murali Krishna, VGS Publishers, Vijayawada
2. Environmental Studies, R. Rajagopalan, 2nd Edition, 2011, Oxford University Press.
3. Environmental Studies, P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani; Pearson Education, Chennai

Reference:
1. Text Book of Environmental Studies, Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.
2. A Textbook of Environmental Studies, Shaashi Chawla, TMH, New Delhi
3. Environmental Studies, Benny Joseph, Tata McGraw Hill Co, New Delhi
4. Perspectives in Environment Studies, Anubha Kaushik, C P Kaushik, New Age International Publishers, 2014

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COURSE STRUCTURE-R19

I Year - II Semester		L	T	P	C
		3	0	0	3
MATHEMATICS - II (BS1202) **(Common to all Branch's for I Year B. Tech)**					

Course Objectives:

- To instruct the concept of Matrices in solving linear algebraic equations
- To elucidate the different numerical methods to solve nonlinear algebraic equations
- To disseminate the use of different numerical techniques for carrying out numerical integration.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

Course Outcomes: At the end of the course, the student will be able to

- develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)

- solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)

- evaluate approximating the roots of polynomial and transcendental equations by different algorithms (L5)

- apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)

- apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations (L3)

Unit I: Solving systems of linear equations, Eigen values and Eigen vectors: **(10 hrs)**

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous equations linear equations – Gauss Elimination for solving system of equations – Eigen values and Eigen vectors and their properties.

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Unit-II: Cayley-Hamilton theorem and Quadratic forms: (10 hrs)

Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation.

Singular values of a matrix, singular value decomposition (Ref. Book – 1).

UNIT III: Iterative methods: (8 hrs)

Introduction – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations.

UNIT IV: Interpolation: (10 hrs)

Introduction – Errors in polynomial interpolation – Finite differences – Forward differences – Backward differences – Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula – Newton's divide difference formula.

UNIT V: Numerical integration and solution of ordinary differential equations: (10 hrs)

Trapezoidal rule – Simpson's $1/3^{rd}$ and $3/8^{th}$ rule – Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Runge-Kutta method (second and fourth order).

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **David Poole,** Linear Algebra- A modern introduction, 4th Edition, Cengage.
2. **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.

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3. **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
4. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

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COURSE STRUCTURE-R19

I Year - II Semester		L	T	P	C
		3	0	0	3
	MATHEMATICS - III (BS1203) **(Common to all Branch's for I Year B. Tech)**				

Course Objectives:

- To familiarize the techniques in partial differential equations
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

Course Outcomes: At the end of the course, the student will be able to

- interpret the physical meaning of different operators such as gradient, curl and divergence (L5)
- estimate the work done against a field, circulation and flux using vector calculus (L5)
- apply the Laplace transform for solving differential equations   (L3)
- find or compute the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- identify solution methods for partial differential equations that model physical processes (L3)

Unit – I: Vector calculus: **(10 hrs)**

Vector Differentiation: Gradient – Directional derivative – Divergence – Curl – Scalar Potential.

Vector Integration: Line integral – Work done – Area – Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof).

Unit –II: Laplace Transforms: **(10 hrs)**

Laplace transforms of standard functions – Shifting theorems – Transforms of derivatives and integrals – Unit step function – Dirac's delta function – Inverse Laplace transforms – Convolution theorem (with out proof).

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COURSE STRUCTURE-R19

Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

Unit –III: Fourier series and Fourier Transforms: **(10 hrs)**

Fourier Series: Introduction – Periodic functions – Fourier series of periodic function – Dirichlet's conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

Fourier Transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Sine and cosine transforms – Properties – inverse transforms – Finite Fourier transforms.

Unit –IV: PDE of first order: **(8 hrs)**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

UNIT V: Second order PDE and Applications: **(10 hrs)**

Second order PDE: Solutions of linear partial differential equations with constant coefficients – RHS term of the type $e^{ax+by}, \sin(ax+by), \cos(ax+by), x^m y^n$.

Applications of PDE: Method of separation of Variables – Solution of One dimensional Wave, Heat and two-dimensional Laplace equation.

Text Books:

1. **B. S. Grewal,** Higher Engineering Mathematics, 43rd Edition, Khanna Publishers.
2. **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.

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3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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COURSE STRUCTURE-R19

I Year - II Semester		L	T	P	C
		3	0	0	3
	APPLIED PHYSICS (BS1204)				

Course Objectives:

      Physics curriculum which is re-oriented to the needs of Circuital branches of graduate engineering courses offered by Jawaharlal Nehru Technological University Kakinada that serves as a transit to understand the branch specific advanced topics. The course is designed to:

➢ Impart Knowledge of Physical Optics phenomena like Interference and Diffraction required to design instruments with higher resolution.
➢ Understand the physics of Semiconductors and their working mechanism for their utility in sensors.
➢ To impart the knowledge of materials with characteristic utility in appliances.

UNIT-I   (10hrs)

WAVE OPTICS: Principle of Superposition - Interference of light - Conditions for sustained Interference - Interference in thin films (reflected geometry) - Newton's Rings (reflected geometry).

Diffraction - Fraunhofer Diffraction - Diffraction due to Single slit (quantitative), Double slit, N-slits and circular aperture (qualitative) – Intensity distribution curves - Diffraction Grating – Grating spectrum – missing order – resolving power – Rayleigh's criterion – Resolving powers of Microscope, Telescope and grating (qualitative).

Unit Outcomes:
The students will be able to

➢ **explain** the need of coherent sources and the conditions for sustained interference.
➢ **analyze** the differences between interference and diffraction with applications.
➢ **illustrate** the resolving power of various optical instruments.

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UNIT-II   (9hrs)

QUANTUM MECHANICS: Introduction – Matter waves – de Broglie's hypothesis – Davisson-Germer experiment – G. P. Thomson experiment – Heisenberg's Uncertainity Principle –interpretation of wave function – Schröedinger Time Independent and Time Dependent wave equations – Particle in a potential box.

Unit Outcomes:

The students will be able to

 ➢ **explain** the fundamental concepts of quantum mechanics.
 ➢ **analyze** the physical significance of wave function.
 ➢ **apply** Schrödinger's wave equation for energy values of a free particle .

UNIT-III   (10hrs)

FREE ELECTRON THEORY & BAND THEORY OF SOLIDS : Introduction – Classical free electron theory (merits and demerits only) - Quantum Free electron theory – electrical conductivity based on quantum free electron theory – Fermi Dirac distribution function – Temperature dependence of Fermi-Dirac distribution function - expression for Fermi energy -

Density of states .

Bloch's theorem (qualitative) – Kronig-Penney model(qualitative) – energy bands in crystalline solids – E Vs K diagram – classification of crystalline solids – effective mass of electron – m^* Vs K diagram - concept of hole.

Unit Outcomes:

The students will be able to

 ➢ **explain** the various electron theories.
 ➢ **calculate** the Fermi energy.
 ➢ **analyze** the physical significance of wave function .
 ➢ **interpret** the effects of temperature on Fermi Dirac distribution function.
 ➢ **summarise** various types of solids based on band theory.

UNIT-IV   (9hrs)

SEMICONDUCTOR PHYSICS: Introduction – Intrinsic semi conductors - density of charge carriers - Electrical conductivity – Fermi level – extrinsic semiconductors - p-type & n-type - Density of charge carriers - Dependence of Fermi energy on carrier concentration and

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temperature – Hall effect- Hall coefficient - Applications of Hall effect - Drift and Diffusion currents – Einstein's equation.

Learning Outcomes:
The students will be able to
 ➢ **classify** the energy bands of semiconductors.
 ➢ **outline** the properties of n-type and p-type semiconductors.
 ➢ **identify** the type of semiconductor using Hall effect.

UNIT-V   (**10 hrs**)

MAGNETISM & DIELECTRICS: Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magneton – Classification of magnetic materials: Dia, para & Ferro – Domain concept of Ferromagnetism - Hysteresis – soft and hard magnetic materials – applications of Ferromagnetic material.

Introduction - Dielectic polarization **–** Dielectric Polarizability, Susceptibility and Dielectric constant-types of polarizations: Electronic and Ionic (Quantitative), Orientational polarizations (qualitative) – Lorentz Internal field – Claussius-Mossoti equation - Frequency dependence of polarization – Applications of dielectrics.

Unit Outcomes:
 The students will be able to
 ➢ **explain** the concept of polarization in dielectric materials.
 ➢ **summarize** various types of polarization of dielectrics .
 ➢ **interpret** Lorentz field and Claussius- Mosotti relation in dielectrics.
 ➢ **classify** the magnetic materials based on susceptibility and their temperature dependence.
 ➢ **explain** the applications of dielectric and magnetic materials .
 ➢ **Apply** the concept of magnetism to magnetic devices.

TEXT BOOKS:

1. "A Text book of Engineering Physics" by M.N. Avadhanulu, P.G.Kshirsagar - S.Chand Publications, 2017.
2. "Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
3. "Engineering Physics" by R.K Gaur. and S.L Gupta., - Dhanpat Rai publishers, 2012.

REFERENCE BOOKS:

1. "Engineering Physics" by M. R. Srinivasan, New Age international publishers (2009).

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2. "Optics" by Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017.
3. "Solid State Physics" by A. J. Dekker, Mc Millan Publishers (2011).

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I Year - II Semester		L	T	P	C
		3	0	0	3
	FUNDAMENTALS OF COMPUTER SCIENCE (ES1212)				

COURSE OBJECTIVES:

This course is designed to:
1. Explain the concepts of computers and classify based on type and generation.
2. Demonstrate the techniques of writing algorithms pseudo codes & schematic flow of logic in software development process.
3. Teach about the purpose of networks and types of networks and media to connect the computers
4. Teach about Operating Systems and its concepts.
5. Illustrate about database architecture and its components
6. Illustrate about distributed computing, peer to peer, grid, cloud on demand and utility computing.

UNIT I:
A Simple Computer System: Central processing unit, the further need of secondary storage, Types of memory, Hardware, Software and people.
Peripheral Devices: Input, Output and storage, Data Preparation, Factors affecting input, Input devices, Output devices, Secondary devices, Communication between the CPU and Input/ Output devices. (Text Book 1)

UNIT II:
Problem Solving and Programming: Algorithm development, Flowcharts, Looping, some programming features, Pseudo code, the one-zero game, some structured programming concepts, documents.
Programming Languages: Machine Language and assembly language, high -level and low level languages, Assemblers, Compilers, and Interpreters (Text Book 1)

UNIT III:
Computer Networks : Introduction to computer Networks, Network topologies-Bus topology, star topology, Ring topology, Mesh topology, Hybrid topology, Types of Networks: Local area Network, Wide Area Networks, Metropolitan Networks, Campus/ Corporate Area Network, Personal Area Network, Network Devices- Hub, Repeater, Switch, Bridge, Router, Gateway, Network interface Card, Open System Inter connection Model (Text Book 2)

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Operating systems: Introduction, Evolution of operating systems, Process Management-Process control block, Process operations, Process scheduling, Command Interpreter, Popular operating systems- Microsoft DOS, Microsoft Windows, UNIX and Linux. (Text Book 2)

UNIT IV:
Database Systems: File-Oriented Approach, Database-oriented Approach-Components of Database system, Advantages & Disadvantages of Database approach, Applications of Database systems, Database views, Three-schema architecture, Database models-Hierarchical model, Network Model, relational Model, Object-oriented Data Model, Components of database management systems, Retrieving Data through Queries (Text Book 2)

Computer Systems and Development: Investigation, Analysis, Design, system processing and general program design, Presentation to management and users, Implementation, Documents. (Text Book 1)

UNIT V:
Emerging Computer Technologies: Distributed Networking, Peer-to-peer Computing, Categorization of Peer-to-peer system Applications of Peer-to-peer networks, Grid Computing-components of Grid computing, Applications of Grid computing,, Cloud Computing-characteristics of cloud computing systems, cloud computing services, cloud computing architecture, cloud computing applications, Cloud computing concerns
Wireless Networks: Wireless network operations, Types of wireless networks, security in wireless Networks, Limitations of wireless Networks, Bluetooth – Bluetooth Piconets, Avoiding Interference in Bluetooth Devices, Bluetooth Security, Differences between Bluetooth and Wireless Networks. (Text Book 2)

TEXT BOOKS:

1. An Introduction to Computer studies –Noel Kalicharan-Cambridge
2. Fundamentals of Computers –Reema Thareja-Oxford higher education

REFERENCES:

1. Introduction to Information Technology – ITL education Solution Limited, Pearson
2. Computer Science and overview-J. Glenn Brookshear, Dennis Brylow-Pearson

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COURSE OUTCOMES:

On completion of the course the student will be able to

1. Explain the concept of input and output devices of Computers and how it works and recognize the basic terminology used in computer programming.
2. Recognize the Computer networks, types of networks and topologies.
3. Summarize the concepts of Operating Systems and Databases.
4. Recite the Advanced Computer Technologies like Distributed Computing & Wireless Networks.

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I Year - II Semester		L	T	P	C
		3	0	0	3
	ELECTRICAL CIRCUIT ANALYSIS - I (ES1217)				

Preamble:
This course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline. The emphasis of this course is laid on the basic analysis of circuits which includes single phase circuits, magnetic circuits, network theorems, transient analysis and network topology.

Learning Objectives:
- To study the concepts of passive elements, types of sources and various network reduction techniques.
- To understand the applications of network topology to electrical circuits.
- To study the concept of magnetic coupled circuit.
- To understand the behavior of RLC networks for sinusoidal excitations.
- To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance.
- To understand the applications of network theorems for analysis of electrical networks.

UNIT-I

Introduction to Electrical Circuits
Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent),Kirchoff's laws, Network reduction techniques(series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis to DC networks with dependent and independent voltage and current sources.

UNIT-II

Magnetic Circuits
Basic definition of MMF, flux and reluctance, analogy between electrical and magnetic circuits, Faraday's laws of electromagnetic induction – concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, analysis of series and parallel magnetic circuits.

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UNIT-III

Single Phase A.C Systems
Periodic waveforms (determination of rms, average value and form factor), concept of phase angle and phase difference – waveforms and phasor diagrams for lagging, leading networks, complex and polar forms of representations.

Steady state analysis of R, L and C circuits,power factor and its significance, real,reactive and apparent power, waveform of instantaneous power and complex power

UNIT-IV

Analysis of AC Networks
Extension of node and mesh analysis to AC networks, series and parallel resonance, selectively band width and Quality factor, introduction to locus diagram.

UNIT-V

Network theorems (DC & AC Excitations)
Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

Learning Outcomes:
The Student should be able to solve
- Various electrical networks in presence of active and passive elements.
- Electrical networks with network topology concepts.
- Any magnetic circuit with various dot conventions.
- Any R, L, C network with sinusoidal excitation.
- Any R, L, network with variation of any one of the parameters i.e R, L, C and f.
- Electrical networks by using principles of network theorems.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley,Mc Graw Hill Company,6 th edition
2. Network Analysis: Van Valkenburg; Prentice-Hall of India Private Ltd

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, Mc Graw Hill Education (India)
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications

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3. Electric Circuits – (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, Adapted by Kuma Rao, 5th Edition – Mc Graw Hill.
4. Electric Circuits by David A. Bell, Oxford publications
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications
6. Circuit Theory(Analysis and Synthesis) by A.Chakrabarthi,Dhanpat Rai&Co.

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I Year - II Semester		L	T	P	C
		0	0	3	1.5
	ELECTRICAL ENGINEERING WORKSHOP (ES1218)				

Learning Objectives:

- To demonstrate the usage of measuring equipment
- To train the students in setting up simple wiring circuits
- To impart methods in electrical machine wiring

Any 10 of the following experiments are to be conducted

1. Study of various electrical tools and symbols.
2. Identify different types of cables/wires and switches, fuses & fuse carriers, MCGB and ELCB, MCCB with ratings and usage.
3. Identification of types of resistors and capacitors.
4. Wiring of light/fan circuit using two way/ three way control (stair case wiring)
5. Go-down wiring/Tunnel wiring
6. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and energy.
7. Measurement of voltage, current, resistance in DC circuit.
8. Measurement of voltage, calculate the power factor of the circuit.
9. Wiring of backup power supply including inverter, battery and load for domestic.
10. Types of earthing, physical implementation.
11. Identification of terminals of different semiconductor devices.
12. Identification of the peripherals of a computer. To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions.Description of various I/O devices, power rating of computers.
13. A practice on disassembling the components of a PC and Assembling them to back to working condition.
14. Hardware trouble shooting (Demonstration): Identification of a problem and fixing a defective PC (improper assembly of peripherals).
15. Software troubleshooting (Demonstration): Identification of a problem and fixing the PC for any software issues.

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Learning Outcomes:
- Explain the limitations, tolerances, safety aspects of electrical systems and wiring.
- Select wires/cables and other accessories used in different types of wiring.
- Make simple lighting and power circuits.
- Measure current, voltage and power in a circuit.

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I Year - II Semester		L	T	P	C
		0	0	3	1.5
	APPLIED PHYSIC LAB (ES1205)				

(Any 10 of the following listed 15 experiments)

LIST OF EXPERIMENTS:

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence.

2. Newton's rings – Radius of Curvature of Plano - Convex Lens.

3. Determination of thickness of a spacer using wedge film and parallel interference fringes.

4. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.

5. Energy Band gap of a Semiconductor p - n junction.

6. Characteristics of Thermistor   – Temperature Coefficients

7. Determination of dielectric constant by charging and discharging method

8. Determination of resistivity of semiconductor by Four probe method.

9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).

10 Measurement of magnetic susceptibility by Gouy's method.

11. Dispersive power of diffraction grating.

12. Resolving Power of telescope

13. Resolving power of grating

14. Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall effect.

15. Variation of dielectric constant with temperature.

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I Year - II Semester		L	T	P	C
		0	1	2	2
	COMMUNICATION SKILLS LAB (HS1203)				

UNIT I:
Oral Activity: JAM, Hypothetical Situations, Self/Peer Profile
Common Errors in Pronunciation, Neutralising Accent

UNIT II:
Oral Activity: Telephonic Etiquette, Role Plays
Poster Presentations

UNIT III:
Oral Activity: Oral Presentation skills, Public speaking
Data Interpretation

UNIT IV:
Oral Activity: Group Discussions: Do's and Don'ts- Types, Modalities

UNIT V:
Oral Activity: Interview Skills: Preparatory Techniques, Frequently asked questions, Mock Interviews.
Pronunciation: Connected speech (Pausing, Tempo, Tone, Fluency etc.,)

References:

1. Infotech English, Maruthi Publications (with Compact Disc).
2. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
3. English Pronunciation in use- Mark Hancock, Cambridge University Press.
4. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
5. English Pronunciation in use- Mark Hewings, Cambridge University Press.
6. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
7. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.
8. Technical Communication- Meenakshi Raman, Sangeeta Sharma, Oxford University Press.
9. Technical Communication- Gajendrea Singh Chauhan, Smita Kashiramka, Cengage Publications.

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COURSE STRUCTURE-R19

I Year - II Semester		L	T	P	C
		0	0	2	1
	ENGINEERING EXPLORATION PROJECT (PR1201)				

COURSE OBJECTIVES:

- Build mindsets & foundations essential for designers
- Learn about the Human-Centered Design methodology and understand their real-world applications
- Use Design Thinking for problem solving methodology for investigating illdefined problems.
- Undergo several design challenges and work towards the final design challenge

Apply Design Thinking on the following Streams to
- Project Stream 1: Electronics, Robotics, IOT and Sensors
- Project Stream 2: Computer Science and IT Applications
- Project Stream 3: Mechanical and Electrical tools
- Project Stream4: Eco-friendly solutions for waste management, infrastructure, safety, alternative energy sources, Agriculture, Environmental science and other fields of engineering.

HOW TO PURSUE THE PROJECT WORK?
- The first part will be learning-based-masking students to embrace the methodology by exploring all the phases of design thinking through the wallet/ bag challenge and podcasts.
- The second part will be more discussion-based and will focus on building some necessary skills as designers and learning about complementary material for human- centered design.
- The class will then divide into teams and they will be working with one another for about 2 – 3 weeks. These teams and design challenges will be the basis for the final project and final presentation to be presented.
- The teams start with **Design Challenge** and go through all the phases more in depth from coming up with the right question to empathizing to ideating to prototyping and to testing.
- Outside of class, students will also be gathering the requirements, identifying the challenges, usability, importance etc
- At the end, Students are required to submit the final reports, and will be evaluated by the faculty.

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TASKS TO BE DONE:

Task 1: Everyone is a Designer
- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast
- Gain a quick introduction to the design thinking methodology
- Go through all stages of the methodology through a simple design challenge
- Podcast: Observe, Listen and Engage with the surrounding environment and identify a design challenge.

Task 3: Teams & Problems
- Start Design Challenge and learn about teams & problems through this
- Foster team collaboration, find inspiration from the environment and learn how to identify problems

Task 4: Empathizing
- Continue Design Challenge and learn empathy
- Learn techniques on how to empathize with users
- Go to the field and interview people in their environments
- Submit Activity Card

Task 5: Ideating
- Continue Design Challenge and learn how to brainstorm effectively
- Encourage exploration and foster spaces for brainstorming
- Submit Activity Card

Task 6: Prototyping
- Continue Design Challenge and learn how to create effective prototypes
- Build tangible models and use them as communication tools
- Start giving constructive feedback to classmates and teammates
- Submit Activity Card

Task 7: Testing
- Finish Design Challenge and iterate prototypes and ideas through user feedback
- Evolve ideas and prototypes through user feedback and constructive criticism
- Get peer feedback on individual and group performance
- Submit Activity Card

Task 8:
- Final Report Submission and Presentation

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Note: The colleges may arrange for Guest Speakers from Various Design Fields: Graphic Design, Industrial Design, Architecture, Product Design, Organizational Design, etc to enrich the students with Design Thinking Concept.

REFERENCES:

1. Tom Kelly, The Art of Innovation: Lessons in Creativity From IDEO, America's Leading Design Firm (Profile Books, 2002)
2. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation (HarperBusiness, 2009)
3. Jeanne Liedtka, Randy Salzman, and Daisy Azer, Design Thinking for the Greater Good: Innovation in the Social Sector (Columbia Business School Publishing, 2017)

OTHER USEFUL DESIGN THINKING FRAMEWORKS AND METHODOLOGIES:

- Human-Centered Design Toolkit (IDEO); https://www.ideo.com/post/design-kit
- Design Thinking Boot Camp Bootleg (Stanford D-School); https://dschool.stanford.edu/resources/the-bootcamp-bootleg
- Collective Action Toolkit (frogdesign); https://www.frogdesign.com/wpcontent/
  - uploads/2016/03/CAT_2.0_English.pdf
- Design Thinking for Educators (IDEO); https://designthinkingforeducators.com/

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II Year – I SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL CIRCUIT ANALYSIS-II				

Preamble :

This course aims at study of three phase systems, transient analysis, network synthesis and fourier analysis for the future study and analysis of power systems.

Learning Objectives:

- To study the concepts of balanced and unbalanced three-phase circuits.
- To study the transient behavior of electrical networks with DC, pulse and AC excitations.
- To study the performance of a network based on input and output excitation/response.
- To understand the realization of electrical network function into electrical equivalent passive elements.
- To understand the application of fourier series and fourier transforms for analysis of electrical circuits.

UNIT-I:

Balanced Three phase circuits

Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents.

Analysis of three phase balanced and unbalanced circuits. Loop method, Star-Delta transformation technique, two wattmeter method for measurement of three phase power.

UNIT-II:

Transient Analysis in DC and AC circuits

Transient response of R-L, R-C, R-L-C circuits for DC and AC excitations, solution using differential equations and Laplace transforms.

UNIT-III:

Two Port Networks

Two port network parameters – Z, Y, Transmission and Inverse Transmission parameters, Hybrid and Inverse hybrid parameters.

Relationships between parameter sets simplification of cascaded and parallel networks.

UNIT-IV:

Fourier analysis

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Fourier theorem – trigonometric form and exponential form of Fourier series, conditions of symmetry – line spectra and phase angle spectra, analysis of electrical circuits to non- sinusoidal periodic waveforms.

UNIT-V:
Fourier Transforms
Fourier integrals and Fourier transforms – properties of Fourier transforms physical significance of the Fourier transform and its application to electrical circuits.

Learning Outcomes:
After the completion of the course the student should be able to:
- solve three- phase circuits under balanced and unbalanced condition.
- find the transient response of electrical networks for different types of excitations.
- find parameters for different types of network.
- realize electrical equivalent network for a given network transfer function.
- extract different harmonics components from the response of an electrical network.

Text Books:
1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley,Mc Graw Hill Company,6 th edition
2. Network synthesis: Van Valkenburg: Prentice-Hall of India Private Ltd.

Reference Books:
1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, Mc Graw Hill Education (India)
2. Introduction to circuit analysis and design by Tildon Glisson. Jr, Springer Publications.
3. Circuits by A.Bruce Carlson , Cengage Learning Publications
4. Network Theory Analysis and Synthesis by Smarajit Ghosh, PHI publications
5. Networks and Systems by D. Roy Choudhury, New Age International publishers
6. Electric Circuits by David A. Bell, Oxford publications
7. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi,Dhanpat Rai&Co.

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II Year – I SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL MACHINES – I				

Preamble:
This is a basic course on rotating electrical machines. This course covers the topics related to principles, performance, applications and design considerations of dc machines and transformers.

Learning objectives:
- Understand the construction, principle of operation and performance of DC machines.
- Learn the characteristics, performance, methods of speed control and testing methods of DC motors.
- To predetermine the performance of single phase transformers with equivalent circuit models.
- Understand the methods of testing of single-phase transformer.
- Analyze the three phase transformers and achieve three phase to two phase conversion.

UNIT–I:
Construction and Operation of DC machines
Construction and principle of operation of DC machine – emf equation for generator – classification of DC machines based on excitation – OCC of DC shunt generator – applications of DC Generators

UNIT–II:
Performance of DC Machines
Torque and back- emf equations of dc motors – Armature reaction and commutation – characteristics of separately-excited, shunt, series and compound motors – losses and efficiency – applications of dc motors.

UNIT-III:
Starting, Speed Control and Testing of DC Machines
Necessity of a starter – starting by 3 point and 4 point starters – speed control by armature voltage and field control.
Testing of DC machines – brake test, Swinburne's method – principle of regenerative or Hopkinson's method – retardation test – separation of losses.

UNIT–IV:
Single-phase Transformers
Types and constructional details – principle of operation – emf equation – operation on no load and on load –phasor diagrams of transformers - equivalent circuit – regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency.

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UNIT-V
Testing of Transformers and 3-Phase Transformers
Tests on single phase transformers – open circuit and short circuit tests – Sumpner's test – separation of losses- parallel operation with equal voltage ratios – auto transformer –comparison with two winding transformers.
Polyphase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ – Scott connection.

Learning outcomes:
After the completion of the course the student should be able to:
- assimilate the concepts of electromechanical energy conversion.
- mitigate the ill-effects of armature reaction and improve commutation in dc machines.
- understand the torque production mechanism and control the speed of dc motors.
- analyze the performance of single phase transformers.
- predetermine regulation, losses and efficiency of single phase transformers.
- parallel transformers, control voltages with tap changing methods and achieve three-phase to two-phase transformation.

Text Books:
1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald,Charles kingsley,Stephen D.Umans, TMH

Reference Books:
1. Electrical Machines by D. P.Kothari, I .J .Nagarth,Mc Graw Hill Publications, 4th edition
2. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition.
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, Mc Graw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman Mc Graw Hill education 2010
5. Electric Machines by Mulukutla S.Sarma&Mukesh k.Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria & Sons

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II Year – I SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRONIC DEVICES AND CIRCUITS				

Preamble:
This course introduces the concepts of semi-conductor physics and operation of various semi-conductor devices. Realization of rectifiers, amplifiers and oscillators using semi-conductor devices, transistors and their analysis is introduced in this course.

Learning Objectives:
- The basic concepts of semiconductor physics are to be reviewed.

- Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.

- The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.

- The principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.

- The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.

- Small signal equivalent circuit analysis of BJT and FET transistor amplifiers in different configuration is explained.

UNIT-I:
Semiconductor Physics : Insulators, Semiconductors, and Metals classification using energy band diagrams, mobility and conductivity, electrons and holes in intrinsic semi conductors, extrinsic semi conductors, drift and diffusion, charge densities in semiconductors, Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

Junction Diode Characteristics : Open circuited P-N junction, Biased P-N junction, P-N junction diode, current components in PN junction Diode, diode equation, V-I characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance, energy band diagram of PN junction Diode.

UNIT-II:
Special Semiconductor Diodes: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Photodiode, Tunnel Diode, SCR, UJT. (Construction, operation and characteristics of all the devices are required to be considered).

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Rectifiers and Filters: Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms, Filters, Inductor filter, Capacitor filter, comparison of various filter circuits in terms of ripple factors.

UNIT- III: Transistor Characteristics:

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through reach through, Photo transistor, typical transistor junction voltage values.
FET: FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT- IV: Transistor Biasing and Thermal Stabilization :

Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE}, Ic, and β, Stability factors, (S, S$'$, S$''$), Bias compensation, Thermal runaway, Thermal stability.FET Biasing- methods and stabilization.

UNIT- V: Small Signal Low Frequency Transistor Amplifier Models:

BJT: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, analysis of CB, CE and CC amplifiers using exact and approximate analysis, comparison of transistor amplifiers.
FET: Generalized analysis of small signal model, analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

Learning Outcomes

After the completion of the course the student should be able to:
- understand the concepts of Semiconductor Technology.
- appraise the construction & operation of electronic devices.
- develop the biasing circuits using the electronic devices.
- model the amplifier circuits.
- analyse the characteristics of the devices.

Text Books:
1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, Second Edition.
2. Electronics devices & circuit theory- Robert L.Boylestad and Loui Nashelsky, Pearson/Prentice hall, tenth edition

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References Books:

1. Electronic Devices and Circuits- Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, Second Edition..
2. Electronic Devices and Circuits – David Bell, Oxford

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II Year – I SEMESTER		L	T	P	C
		3	0	0	3
	ELECTROMAGNETIC FIELDS				

Preamble:

Electromagnetic field theory is the pre-requisite for most of the subjects in the gamut of electrical engineering. The study of this subject enables students to understand and interpret the phenomenon pertinent to electrical engineering using microscopic quantities such as electric and magnetic field intensities, scalar and vector potentials.

Learning objectives:
- To study the production of electric field and potentials due to different configurations of static charges.
- To study the properties of conductors and dielectrics, calculate the capacitance of different configurations. Understand the concept of conduction and convection current densities.
- To study the magnetic fields produced by currents in different configurations, application of Ampere's law and the Maxwell's second and third equations.
- To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
- To develop the concept of self and mutual inductances and the energy stored.
- To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced EMF

UNIT – I:
Electrostatics
Scalar and vector fields, overview of coordinate system, calculus of scalar and vector fields in Cartesian coordinates – Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, electric potential – properties of potential function – potential gradient, Guass's law –Laplace's and Poison's equations.

UNIT – II:
Conductors – Dielectrics and Capacitance
Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque on an Electric dipole in an electric field conductors and Insulators – their behaviour in electric field.
Polarization, boundary conditions between conductors to dielectric.Capacitance of parallel plates, spherical and coaxial cable, energy stored and energy density in a static electric field, equation of continuity.

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UNIT – III:
Magneto statics and Ampere's Law
Biot-Savart's law, Magnetic Field Intensity (MFI) – MFI due to a straight current carrying filament, MFI due to circular, square and solenoid current – carrying wire – relation between magnetic flux, magnetic flux density and MFI. Maxwell's second Equation, div(B)=0, Ampere's circuital law and its applications viz. MFI due to an infinite sheet of current and a long filament carrying conductor, point form of Ampere's circuital law, field due to a rectangular loops, Maxwell's third equation, Curl (H)=J.
Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors, magnetic dipole and dipole moment – a differential current loop as a magnetic dipole – Torque on a current loop placed in a magnetic field.

UNIT – IV:
Self and mutual inductance
Self and mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT – V:
Time Varying Fields
Time varying fields: Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation, Curl (E)=-∂B/∂t, statically and dynamically induced EMF.

Learning outcomes:
After the completion of the course the student should be able to:
- determine electric fields and potentials using Guass's law or solving Laplace's or Possion's equations, for various electric charge distributions.
- calculate and design capacitance, energy stored in dielectrics.
- calculate the magnetic field intensity due to current, the application of Ampere's law and the Maxwell's second and third equations.
- determine the magnetic forces and torque produced by currents in magnetic field
- determine self and mutual inductances and the energy stored in the magnetic field.
- calculate induced EMF, understand the concepts of displacement current and Poynting vector.

Text Books:
1. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill Companies, 7th Editon.2006.

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Reference Books:

1. " Principles of Electro Magnetics" by Sadiku, Oxford Publications,4th edition
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd edition
3. "Electromagnetic Field Theory" by Yaduvir Singh,Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan,Oxford higher Education.

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II Year – I SEMESTER		L	T	P	C
		3	0	0	3
	THERMAL AND HYDRO PRIME MOVERS				

Part-A: Thermal Prime Movers

Course Objectives: To make the student understand the types of prime movers, which can be connected to generators for power production and should obtain the skills of performing the necessary calculations with respect to the functioning of the prime movers.

UNIT I:

Objectives: To make the student learn about the constructional features, operational details of various types of internal combustion engines through the details of several engine systems and the basic air standard cycles, that govern the engines. Further, the student shall be able to calculate the performance of different types of internal combustion engines.

I.C Engines: Classification, working principles – valve and port timing diagrams – air standard cycles – Engine systems line fuel injection, carburetion, ignition, cooling and lubrication – Engine performance evaluation.

UNIT II:

Objectives: To train the student in the aspects of steam formation and its utilities through the standard steam data tables and charts. To make the student correlate between the air standard cycles and the actual cycles that govern the steam turbines. To train the student to calculate the performance of steam turbines using velocity diagrams.

Properties of Steam and use of Steam Tables- T-S and H-S Diagrams. Analysis of various Thermodynamic and processes under gone by Steam.

Vapor Power Cycles: Carnot Cycle-Rankine Cycle- Thermodynamic variables Effecting Efficiency and output of Rankine Cycle-. Analysis of simple Rankine Cycle and Re-heat cycle.

Steam Turbines: Schematic layout of steam power plant – Classification of steam Turbines – Impulse Turbine and Reaction Turbine - Compounding in Turbines – Velocity Diagrams for simple Impulse and Reaction Turbines – Work done & Efficiency.

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UNIT III:

Objectives: To impart the knowledge of gas turbine fundamentals, the governing cycles and the method to improve the efficiency of gas turbines.

Gas Turbines: Simple gas turbine plant-ideal cycle, closed cycle - open cycle – Efficiency, Work ratio and optimum pressure ratio for simple gas turbine cycle. Actual cycle, analysis of simple cycles & cycles with inter cooling, reheating and regeneration.

Part-B: Hydro Prime Movers

UNIT IV:

Objectives: to teach the student about the fundamental of fluid dynamic equations and its applications fluid jets. To impart the knowledge of various types of pumps, their constructional features, working and performance.

IMPACT OF JETS AND PUMPS: Impulse momentum equation, Impact of Jet on stationary and moving vanes (flat and curved). Pumps: Types of pumps, Centrifugal pumps: Main components, Working principle, Multi stage pumps, Performance and Characteristic curves.

UNIT V:

Objectives: To make the student learn about the constructional features, operational details of various types of hydraulic turbines. Further, the student shall be able to calculate the performance of hydraulic turbines.

HYDRAULIC TURBINES: Classifications of turbines; Working principle, Efficiency calculation and Design principles for Pelton Wheel, Francis and for Kaplan turbines; Governing of turbines; Performance and characteristic curves.

HYDRO POWER: Components of Hydro electric power plant; pumped storage systems, Estimation of water power potential ; Estimation of load on turbines load curve, load factor, capacity factor, utilization factor, diversity factor, load- duration curve, firm power, secondary power, prediction of load.

Text Books:
1. Thermal Engineering by Rajput, Lakshmi publications.
2. Thermal engineering by M.L.Mathur and F.S.Mehta, Jain Brothers.

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3. Hydraulics & Fluid Mechanics, P.N.Modi and S.M.Seth, Standard Book House, Delhi.

Reference Books:
1. Fluid Mechanic & Hydraulic Machinery, A.K.Jain, Khanna Publishers, Delhi.
2. "Fluid Mechanics" by Victor.L.Streeter.
3. "Introduction to Fluid Mechanics" Edward.J.Shaughnessy Jr.
4. "Fluid Mechanics & Its Applications", Vijay Gupta, Santosh.k.Gupta
5. "Fluid Mechanic & Fluid Power Engineering", Dr.D.S.Kumar
6. "Water Power Engineering", M.M.Desumukh

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		L	T	P	C
II Year – I SEMESTER		3	0	0	3
	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS				

Course Objectives:
- The Learning objectives of this paper are to understand the concept and nature of Managerial Economics and its relationship with other disciplines and also to understand the Concept of Demand and Demand forecasting.
- To familiarize about the Production function, Input Output relationship, Cost-Output relationship and Cost-Volume-Profit Analysis.
- To understand the nature of markets, Methods of Pricing in the different market structures and to know the different forms of Business organization and the concept of Business Cycles.
- To learn different Accounting Systems, preparation of Financial Statement and uses of different tools for performance evaluation.
- Finally, it is also to understand the concept of Capital, Capital Budgeting and the techniques used to evaluate Capital Budgeting proposals.

Unit-I
Introduction to Managerial Economics and demand Analysis:
Definition of Managerial Economics –Scope of Managerial Economics and its relationship with other subjects –Concept of Demand, Types of Demand, Determinants of Demand- Demand schedule, Demand curve, Law of Demand and its limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement- Demand forecasting and Methods of forecasting, Concept of Supply and Law of Supply.

Unit – II:
Theories of Production and Cost Analyses:
Theories of Production function- Law of Variable proportions-Isoquants and Isocosts and choice of least cost factor combination-Concepts of Returns to scale and Economies of scale-Different cost concepts: opportunity costs, explicit and implicit costs-Fixed costs, Variable Costs and Total costs –Cost –Volume-Profit analysis-Determination of Breakeven point(problems)-Managerial significance and limitations of Breakeven point.

Unit – III:
Introduction to Markets, Theories of the Firm & Pricing Policies:
Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles : Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

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Unit – IV:
Introduction to Accounting & Financing Analysis:
Introduction to Double Entry System, Journal, Ledger, Trail Balance and Preparation of Final Accounts with adjustments – Preparation of Financial Statements-Analysis and Interpretation of Financial Statements-Ratio Analysis – Preparation of Funds flow and cash flow analysis (Problems)

Unit – V:
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capital-Capitalization-Meaning of Capital Budgeting-Time value of money- Methods of appraising Project profitability: Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value method, Internal Rate of Return Method and Profitability Index)

Course Outcomes:
- The Learner is equipped with the knowledge of estimating the Demand and demand elasticities for a product.
- The knowledge of understanding of the Input-Output-Cost relationships and estimation of the least cost combination of inputs.
- The pupil is also ready to understand the nature of different markets and Price Output determination under various market conditions and also to have the knowledge of different Business Units.
- The Learner is able to prepare Financial Statements and the usage of various Accounting tools for Analysis.
- The Learner can able to evaluate various investment project proposals with the help of capital budgeting techniques for decision making.

TEXT BOOKS:
A R Aryasri, Managerial Economics and Financial Analysis, The McGraw – Hill companies.

REFERENCES:
1. Varshney R.L, K.L Maheswari, Managerial Economics, S. Chand & Company Ltd,
2. JL Pappas and EF Brigham, Managerial Economics, Holt, R & W; New edition edition
3. N.P Srinivasn and M. SakthivelMurugan, Accounting for Management, S. Chand & Company Ltd,
4. MaheswariS.N,AnIntroduction to Accountancy, Vikas Publishing House Pvt Ltd
5. I.M Pandey, Financial Management , Vikas Publishing House Pvt Ltd
6. V. Maheswari, Managerial Economics, S. Chand & Company Ltd,

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II Year – I SEMESTER		L	T	P	C
		0	0	3	1.5
	THERMAL AND HYDRO LABORATORY				

Course Objective: To impart practical knowledge on the performance evaluation methods of various internal combustion engines, flow measuring equipment and hydraulic turbines and pumps.

NOTE: TO CONDUCT MINIMUM OF 12 EXPERIMENTS BY CONDUCTING MINIMUM OF SIX FROM EACH SECTION.

SECTION A - THERMAL ENGINEERING LAB

1. I.C. Engines valve / port timing diagrams.
2. I.C. Engines performance test on 4 -stroke Diesel engine.
3. I.C. Engines performance test on 2-stroke petrol engine.
4. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine
5. Determination of FP by retardation and motoring test on IC engine
6. I.C. Engine heat balance on petrol / Diesel engines.
7. Economical speed test of an IC engine
8. Study of boilers

SECTION B –HYDRAULIC MACHINES LAB

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Reciprocating Pump.
7. Calibration of Venturimeter.
8. Calibration of Orifice meter.
9. Determination of loss of head due to sudden contraction in a pipeline.

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		L	T	P	C
II Year – I SEMESTER		0	0	3	1.5
	ELECTRICAL CIRCUITS LABORATORY				

Learning objectives:

To verify and demonstrate various theorems, locus diagrams, resonance and two port networks. To determine self and mutual inductance of a magnetic circuit, parameters of a given coil and measurement of 3- phase power.

Any 10 of the following experiments are to be conducted:

1) Verification of Thevenin's and Norton's Theorems.
2) Verification of superposition theorem and maximum power transfer theorem
3) Verification of compensation theorem
4) Verification of reciprocity, Millmann's Theorems
5) Determination of time constants of R-L, R-C networks using CRO.
6) Series and parallel resonance
7) Determination of self, mutual inductances and coefficient of coupling
8) Z and Y Parameters
9) Transmissionand hybrid parameters
10) Parameters of a choke coil.
11) Determination of cold and hot resistance of an electric lamp.
12) Measurement of 3-phase power by two Wattmeter method for unbalanced loads

Learning outcomes:

The Student should be able to apply various theorems, determination of self and mutual inductances, two port parameters of a given electric circuits. Able to draw locus diagrams, waveforms and phasor diagrams for lagging and leading networks.

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II Year – I SEMESTER		L	T	P	C
		3	0	0	0
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE					

Course Objectives:
To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system
- The course aim of the importing basic principle of third process reasoning and inference sustainability is at the course of Indian traditional knowledge system
- To understand the legal framework and traditional knowledge and biological diversity act 2002 and geographical indication act 2003
- The courses focus on traditional knowledge and intellectual property mechanism of traditional knowledge and protection
- To know the student traditional knowledge in different sector

Course Outcomes:
After completion of the course, students will be able to:
- Understand the concept of Traditional knowledge and its importance
- Know the need and importance of protecting traditional knowledge
- Know the various enactments related to the protection of traditional knowledge
- Understand the concepts of Intellectual property to protect the traditional knowledge

UNIT I
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge
Learning Outcomes:
At the end of the unit, the student will able to:
- Understand the traditional knowledge.
- Contrast and compare characteristics importance kinds of traditional knowledge.
- Analyze physical and social contexts of traditional knowledge.
- Evaluate social change on traditional knowledge.

UNIT II
Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.
Learning Outcomes:
At the end of the unit, the student will able to:
- Know the need of protecting traditional knowledge.
- Apply significance of tk protection.

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- Analyze the value of tk in global economy.
- Evaluate role of government

UNIT III

Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act);B:The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003.

Learning Outcomes:

At the end of the unit the student will able to:
- Understand legal framework of TK.
- Contrast and compare the ST and other traditional forest dwellers
- Analyze plant variant protections
- Evaluate farmers right act

UNIT IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

Learning Outcomes:

At the end of the unit, the student will able to:
- Understand TK and IPR
- Apply systems of TK protection.
- Analyze legal concepts for the protection of TK.
- Evaluate strategies to increase the protection of TK.

UNIT V

Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Learning Outcomes:

At the end of the unit, the student will able to:
- Know TK in different sectors.
- Apply TK in engineering.
- Analyze TK in various sectors.
- Evaluate food security and protection of TK in the country.

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Reference Books:
1) Traditional Knowledge System in India, by Amit Jha, 2009.
2) Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, PratibhaPrakashan 2012.
3) Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4) "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

e-Resources:
1) https://www.youtube.com/watch?v=LZP1StpYEPM
2) http://nptel.ac.in/courses/121106003/

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II Year – II SEMESTER		L	T	P	C
		3	0	0	3
ELECTRICAL MEASUREMENTS AND INSTRUMENTATION					

Preamble:
This course introduces the principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Learning Objectives:
- To study the principle of operation and working of different types of instruments for measurement of Electrical Quantities.
- To study the working principle of operation of different types of instruments for measurement of power and power factor.
- To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
- To understand the principle of operation and working of transducers.
- To study the principle of operation and working of DVMS, Power analyser and applications of CRO.

UNIT–I:
Analog Ammeter and Voltmeters
Classification – deflecting, control and damping torques,– PMMC, moving iron type and electrostatic instruments, Construction, Torque equation, Range extension, Effect of temperature, Errors and compensations, advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer-construction, theory, errors-Numerical Problems.

UNIT –II:
Analog Wattmeters and Power Factor Meters
Electrodynamometer type wattmeter (LPF and UPF), Power factor meters: Dynamometer and M.I type (Single phase and Three phase), construction, theory, torque equation, advantages and disadvantages -Numerical Problems.

UNIT – III:
Measurements of Electrical parameters
DC Bridges: Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge, Kelvin's double bridge for measuring low resistance, Loss of charge method for measurement of high resistance, Megger – measurement of earth resistance - Numerical Problems.

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AC Bridges: Measurement of inductance – quality factor, Maxwell's bridge, Hay's bridge, Anderson's bridge, measurement of capacitance and loss angle, Desauty's bridge, Schering Bridge, Wagner's earthing device, Wien's bridge- Numerical Problems.

UNIT – IV:
Transducers
Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Digital shaft encoders, Hall effect sensors- Numerical Problems.

UNIT – V:
Digital meters

Digital voltmeter – Successive approximation DVM, Ramp type DVM and Integrating type DVM – Digital frequency meter, Digital multimeter, Digital tachometer, Digital Energy Meter, LCR Q meter, Power Analyzer-Measurement of phase difference, Frequency, hysteresis loop using lissajious patterns in CRO- Numerical Problems.

Learning Outcomes:
After the completion of the course the student should be able to:
- choose right type of instrument for measurement of ac and dc Electrical quantities.
- choose right type of instrument for measurement of power and power factor.
- select right type for measurement of R, L,C.
- understand the effectiveness of Transducer.
- able to understand Digital Meters.

Text Books:
1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:
1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
3. Electrical Measurements by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

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II Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL MACHINES – II				

Preamble:
This course covers the topics on 3-phase induction motor, 1-phase induction motor and synchronous machines which have wide application in power systems. The main aim of the course is to provide a detailed analysis of operation and performance of 3-phase induction motor, 1-phase induction motor and synchronous machines. In addition, it also covers voltage regulation and parallel operation of synchronous generators.

Learning objectives:
- Understand the principle of operation and performance of 3-phase induction motor.
- Quantify the performance of induction motor and induction generator in terms of torque and slip.
- To understand the torque producing mechanism of a single phase induction motor.
- To understand the principle of emf generation, the effect of armature reaction and predetermination of voltage regulation in synchronous generators.
- To study parallel operation and control of real and reactive powers for synchronous generators.
- To understand the operation, performance and starting methods of synchronous motors.

UNIT-I:
3-phase induction motors
Construction details of cage and wound rotor machines – production of rotating magnetic field – principle of operation – rotor emf and rotor frequency – rotor current and power factor at standstill and during running conditions – rotor power input, rotor copper loss and mechanical power developed and their interrelationship – equivalent circuit – phasor diagram

UNIT-II:
Characteristics, starting and testing methods of induction motors
Torque   equation – expressions for maximum torque and starting torque – torque   slip characteristic –double cage and deep bar rotors – crawling and cogging – speed control of induction motor with V/f control method –no load and blocked rotor tests – circle diagram for predetermination of performance – methods of starting –starting current and torque calculations – induction generator operation (Qualitative treatment only)

UNIT – III:
Single Phase Motors
Single phase induction motors – constructional features and equivalent circuit – problem of starting– double revolving field theory

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Starting methods, AC series motor.

UNIT–IV:
Construction, operation and voltage regulation of synchronous generator
Constructional features of non-salient and salient pole type armature windings – distributed and concentrated windings – distribution, pitch and winding factors – E.M.F equation – improvements of waveform and armature reaction – voltage regulation by synchronous impedance method –MMF method and Potier triangle method – phasor diagrams – two reaction analysis of salient pole machines and phasor diagram.
Parallel operation with infinite bus and other alternators – synchronizing power – load sharing – control of real and reactive power – numerical problems.

UNIT–V:
Synchronous motor – operation, starting and performance
Synchronous motor principle and theory of operation – phasor diagram – starting torque – variation of current and power factor with excitation –synchronous condenser – mathematical analysis for power developed– hunting and its suppression – methods of starting – applications.

Learning outcomes:
 After the completion of the course the student should be able to:
- explain the operation and performance of three phase induction motor.
- analyze the torque-speed relation, performance of induction motor and induction generator.
- explain design procedure for transformers and three phase induction motors.
- implement the starting of single phase induction motors.
- perform winding design and predetermine the regulation of synchronous generators.
- avoid hunting phenomenon, implement methods of staring and correction of power factor with synchronous motor.

Text Books:
1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald,Charles kingsley,Stephen D.Umans, TMH

Reference Books:
1. Electrical Machines by D. P.Kothari, I .J .Nagarth,Mc Graw Hill Publications, 4th edition
2. Electrical Machines by R.K.Rajput, Lakshmi publications,5th edition
3. Electrical Machinery by Abijith Chakrabarthi and Sudhipta Debnath, Mc Graw Hill education 2015
4. Electrical Machinery Fundamentals by Stephen J Chapman Mc Graw Hill education 2010
5. Electric Machines by Mulukutla S.Sarma&Mukesh k.Pathak, CENGAGE Learning.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria & Sons

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7. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House
7. Performance and design of AC machines – M.G. Say.

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II Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL ELECTRONICS				

Preamble:
This course covers the topics related to representation numbers in different radix formats, complements and codes. It also introduces the basic gates and their realization in SOP and POS form. Boolean algebra and various logic gates minimization process is introduced. Design principles of combinational and sequential circuits are explained to make the students thorough in design of these circuits.

Course Objectives:
- To solve a typical number base conversion and analyze new error coding techniques.
- Theorems and functions of Boolean algebra and behavior of logic gates.
- To optimize logic gates for digital circuits using various techniques.
- To understand concepts of combinational circuits.
- To develop advanced sequential circuits.

UNIT – I:
Review of Number Systems & Codes:
Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed numbers, problem solving. 4 bit codes, BCD, Excess-3, 2421, 84-2-1 9s & 10s compliment code etc.,

Logic operations and error detection & correction codes; Basic logic operations -NOT, OR, AND, Universal building blocks, EX-OR, EX-NOR - Gates, Standard SOP and POS, Forms, Gray code, error detection, error correction codes (parity checking, even parity, odd parity, Hamming code) NAND-NAND and NOR-NOR realizations.

UNIT – II:
Minimization Techniques
Boolean theorems, principle of complementation & duality, De-morgan theorems, minimization of logic functions using Boolean theorems, minimization of switching functions using K-Map up to 6 variables, tabular minimization, problem solving (code-converters using K-Map etc..).

UNIT – III:
Combinational Logic Circuits Design

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Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders, 4-bit binary subtractor, adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit, look-a-head adder circuit, Design of decoder, demultiplexer, 7 segment decoder, higher order demultiplexing, encoder, multiplexer, higher order multiplexing, realization of Boolean functions using decoders and multiplexers, priority encoder, 4-bit digital comparator.

UNIT – IV:
Sequential Circuits I

Classification of sequential circuits (synchronous and asynchronous); basic flip-flops, truth tables and excitation tables (NAND RS latch, NOR RS latch, RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals). Conversion from one flip-flop to another. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bi-directional shift register, universal shift register.

UNIT – V:
Sequential Circuits II

Finite state machine; Analysis of clocked sequential circuits, state diagrams, state tables, reduction of state tables and state assignment, design procedures. Realization of circuits using various flip-flops. Mellay to Moore conversion and vice-versa.

Course Outcomes:
After the completion of the course the student should be able to:
- classify different number systems and apply to generate various codes.
- use the concept of Boolean algebra in minimization of switching functions
- design different types of combinational logic circuits.
- apply knowledge of flip-flops in designing of Registers and counters
- the operation and design methodology for synchronous sequential circuits and algorithmic state machines.
- produce innovative designs by modifying the traditional design techniques.

Text Books:
1. Zvi kohavi and Niraj K.Jha, " Switching and finite Automata Theory", Cambridge University Press, 3rd edition, 2010.
2. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition.
3. Digital Design by M. Morrics Mano, Micheal D.Ciletti, Pearson Publication 4Th edition. PHI.

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4. Digital Principles And Applications by Albert Paul Malvino, Donald P Leach TMH edition.

Reference Books:
1. Switching Theory and Logic Design by A. Anand Kumar
2. Modern Digital Electronics by RP Jain, TMH
3. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers
4. Digital electronics logic and design-Cherry Bhargava, BS Publications, 2019.

Web Links:
1. https://www.youtube.com/watch?v=CeD2L6KbtVM
2. Lecture series on Digital Circuits & Systems by Prof.S.Srinivasan, Department of Electrical Engineering, IIT Madras.For more details on NPTEL visit http://nptel.iitm.ac.in
3. https://www.youtube.com/watch?v=K73N9ES_8nI
4. https://www.youtube.com/watch?v=62WxkICo2Bc

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COURSE STRUCTURE-R19

II Year – II SEMESTER		L	T	P	C
		3	0	0	3
	CONTROL SYSTEMS				

Preamble:
This course introduces the elements of linear control systems and their analysis. Classical methods of design using frequency response. The state space approach for design, modeling and analysis of simple PD, PID controllers.

Learning Objectives:
- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers
- To investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
- To discuss basic aspects of design and compensation of linear control system using Bode plot.
- To present the Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
- Ability to formulate state models and analyze the systems. To learn the concepts of Controllability and Observability.

UNIT – I:
Mathematical Modeling of Control Systems
Classification of control systems, open loop and closed loop control systems and their differences, Feedback characteristics, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems, transfer function of DC servo motor – AC servo motor – synchro, transmitter and receiver – block diagram algebra – representation by signal flow graph – reduction using Mason's gain formula.

UNIT-II:
Time Response Analysis
Standard test signals – time response of first and second order systems – time domain specifications, steady state errors and error constants, P, PI,

Stability and Root Locus Technique

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The concept of stability – Routh's stability criterion –limitations of Routh's stability, Root locus concept – construction of root loci (simple problems).Effect of addition of poles and zeros root locus

UNIT–III:
Frequency Response Analysis
Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram – phase margin and gain margin – stability analysis from Bode plots.
Polar plots, Nyquist stability criterion.

UNIT–IV:
Classical Control Design Techniques
Lag, lead, lag-lead compensators, design of compensators using Bode plots.

UNIT–V:
State Space Analysis of LTI Systems
Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and it's Properties, concepts of controllability and observability.

Learning Outcome:
After the completion of the course the student should be able to:
- derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- determine time response specifications of second order systems and to determine error constants.
- analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
- analyze the stability of LTI systems using frequency response methods.
- design Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
- represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:
1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India,2nd Edition.

Reference Books:

1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
2. Control Systems by Manik Dhanesh N, Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
4. Control Systems Engineering by S.Palani,Tata Mc Graw Hill Publications.

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COURSE STRUCTURE-R19

II Year – II SEMESTER		L	T	P	C
		3	0	0	3
	POWER SYSTEMS-I				

Preamble:
Electrical Power plays significant role in day to day life of entire mankind. The aim of this course is to allow the students to understand the concepts of the generation and distribution of power along with economic aspects.

Learning objectives :
- To study the principle of operation of different components of a thermal power stations.
- To study the principle of operation of different components of a Nuclear power stations.
- To study the constructional and operation of different components of an Air and Gas Insulated substations.
- To study the constructional details of different types of cables.
- To study different types of load curves and tariffs applicable to consumers.

UNIT-I:
Thermal Power Stations
Selection of site, general layout of a thermal power plant showing paths of coal, steam, water, air, ash and flue gasses, ash handling system, Brief description of components: boilers, super heaters, economizers, electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

UNIT-II:
Nuclear Power Stations
Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants,types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

UNIT-III:
Substations
Classification of substations:
Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment.
Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

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Gas Insulated Substations (GIS) – advantages of gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations, constructional aspects of GIS, installation and maintenance of GIS, comparison of air insulated substations and gas insulated substations.

UNIT-IV:
Underground Cables
Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable.
capacitance of single and 3-Core belted Cables: Grading of cables – capacitance grading and intersheath grading.

UNIT-V:
Economic Aspects of Power Generation & Tariff
Economic Aspects –load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, power capacity factor and plant use factor, base and peak load plants.
Tariff Methods– costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.

Learning Outcomes:
After the completion of the course the student should be able to:
* identify the different components of thermal power plants.
* identify the different components of nuclear Power plants.
* identify the different components of air and gas insulated substations.
* identify single core and three core cables with different insulating materials.
* analyse the different economic factors of power generation and tariffs.

Text Books:
1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd.
2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.

Reference Books:
1. Electrical Power Distribution Systems by V. Kamaraju, Tata Mc Graw Hill, New Delhi.
2. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.

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II Year – II SEMESTER		L	T	P	C
		3	0	0	3
	SIGNALS AND SYSTEMS				

Preamble:

This course introduces the fundamental concepts of various types signals and their properties and mathematical operations on the signals. Fourier series, Fourier and Hilbert transforms are introduced to analyze the signals. Sampling theorem and Parsevel's theorem are introduced to design and analysis of filters. Laplace and Z-transforms are used for the analysis of signals.

Course Objectives:

- To introduce the terminology of signals and systems.
- To introduce Fourier tools through the analogy between vectors and signals.
- To introduce the concept of sampling and reconstruction of signals.
- To analyze the linear systems in time and frequency domains.
- To study z-transform as mathematical tool to analyze discrete-time signals and systems.

UNIT- I:

Introduction

Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude-shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function. Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, closed or complete set of orthogonal functions, Orthogonality in complex functions.

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UNIT –II:
Fourier Series And Fourier Transform:
Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Complex Fourier spectrum. Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform.

UNIT –III:
Sampling Theorem
Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling.

UNIT-IV:
Analysis of Linear Systems
Linear system, impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.
Cross-correlation and auto-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation.

UNIT –V:
Laplace Transforms
Review of Laplace transforms, Partial fraction expansion, Inverse Laplace transform, Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Relation between L.T's, and F.T. of a signal.

Z–Transforms
Fundamental difference between continuous-time and discrete-time signals,discrete time signal representation using complex exponential and sinusoidal components, Periodicity of discrete time using complex exponential signal, Concept of Z- Transform of a discrete sequence.

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Distinction between Laplace, Fourier and Z transforms. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms.

Course Outcomes:

After the completion of the course the student should be able to:

- characterize the signals and systems and principles of vector spaces, Concept of orthgonality.
- analyze the continuous-time signals and continuous-time systems using Fourier series, Fourier transform and Laplace transform.
- apply sampling theorem to convert continuous-time signals to discrete-time signal and reconstruct back.
- understand the relationships among the various representations of LTI systems
- understand the Concepts of convolution, correlation, Energy and Power density spectrum and their relationships.
- apply z-transform to analyze discrete-time signals and systems.

Text Books:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
3. Signals & Systems- Narayan Iyer and K Satya Prasad, Cenage Pub.

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition.
2. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
3. Signals and Systems – Signals and Systems – M.J. Roberts,3rd Edition,MC Graw-Hill,2019.
4. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, 2008.
5. Signals and Systems – T K Rawat , Oxford University press, 2011

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II Year – II SEMESTER		L	T	P	C
		0	0	3	1.5

ELECTRICAL MACHINES – I LABORATORY

Learning objectives:
- To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- To control the speed of DC motors.
- To determine and predetermine the performance of DC machines.
- To predetermine the efficiency and regulation of transformers and assess their performance.

Any 10 of the following experiments are to be conducted

1. Magnetization characteristics of DC shunt generator.
2. Brake test on DC shunt motor.
3. Hopkinson's test on DC shunt machines.
4. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
5. Speed control of DC shunt motor by Field and Armature Control.
6. Retardation test on DC shunt motor..
7. Separation of losses in DC shunt motor.
8. OC & SC test on single phase transformer.
9. Sumpner's test on single phase transformer.
10. Scott connection of transformers
11. Parallel operation of Single phase Transformers
12. Separation of core losses of a single phase transformer
13. Heat run test on a bank of 3 Nos. of single phase Delta connected transformers

Learning outcomes:
After the completion of the course the student should be able to:
- Determine and predetermine the performance of DC machines and Transformers.
- Control the speed of DC motor.
- Obtain three phase to two phase transformation.

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II Year – II SEMESTER		L	T	P	C
		0	0	3	1.5
ELECTRONIC DEVICES & CIRCUITS LABORATORY					

Electronic Workshop Practice:

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Coils, Gang condensers, Relays, Bread Boards.
2. Identification,Specifications and Testing of active devices, Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT.
3. Soldering Practice- Simple circuits using active and passive components.
4. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function
5. Generator, Regulated Power Supply and CRO..

List of Experiments
Any 10 of the following experiments are to be conducted

1. P.N Junction Diode Characteristics
     Part A: Germanium Diode (Forward bias& Reverse bias)
      Part B: Silicon Diode (Forward Bias only)
2. Zener Diode Characteristics
Part A: V-I Characteristic
      Part B: Zener Diode as Voltage Regulator
3.   Rectifiers (without and with c-filter)
          Part A: Half-wave Rectifier
          Part B : Full-wave Rectifier
4. BJT Characteristics (CE Configuration)
          Part A: Input Characteristics
          Part B: output Characteristics
5. FET Characteristics
          Part A: Drain Characteristics
          Part B: Transfer Characteristics
6. SCR Characteristics
7. UJT Characteristics
8. Transistor Biasing
9. CRO Operation and its Measurement
10. BJT-CE Amplifier
11. Emitter Follower –CC Amplifier

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12.FET-CS Amplifier

Note: The students are required to perform the experiment to obtain the V-I characteristics and to determine the relevant parameters from the obtained graphs.

Equipment required:

1.Regulated Power supplies
2.Analog/Digital Storage Oscilloscopes
3.Analog/Digital Function Generators
4.Digital Multimeters
5.Decade Résistance Boxes/Rheostats
6.Decade Capacitance Boxes
7.Ammeters (Analog or Digital)
8.Voltmeters (Analog or Digital)
9.Active & Passive Electronic Components

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II Year – II SEMESTER		L	T	P	C
		3	0	0	0
PROFESSIONAL ETHICS AND HUMAN VALUES					

Course Objectives:
- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and Loyalty
- To appreciate the rights of others
- To create awareness on assessment of safety and risk

Course outcomes:

Students will be able to:
- Identify and analyze an ethical issue in the subject matter under investigation or in a relevant field
- Identify the multiple ethical interests at stake in a real-world situation or practice
- Articulate what makes a particular course of action ethically defensible
- Assess their own ethical values and the social context of problems
- Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects
- Demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work
- Integrate, synthesize, and apply knowledge of ethical dilemmas and resolutions in academic settings, including focused and interdisciplinary research.

UNIT I

Human Values: Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others –Living Peacefully –Caring –Sharing –Honesty -Courage-Cooperation– Commitment – Empathy –Self Confidence Character –Spirituality.

Learning outcomes:
1. Learn about morals, values & work ethics.
2. Learn to respect others and develop civic virtue.
3. Develop commitment
4. Learn how to live peacefully

UNIT II

Engineering Ethics: Senses of 'Engineering Ethics-Variety of moral issued –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 –Valuing time –Cooperation –Commitment.

Learning outcomes:
1. Learn about the ethical responsibilities of the engineers.
2. Create awareness about the customs and religions.

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3. Learn time management
4. Learn about the different professional roles.

UNIT III

Engineering as Social Experimentation**:** Engineering As Social Experimentation –Framing the problem –Determining the facts –Codes of Ethics –Clarifying Concepts –Application issues –Common Ground -General Principles –Utilitarian thinking respect for persons.

Learning outcomes:

1. Demonstrate knowledge to become a social experimenter.
2. Provide depth knowledge on framing of the problem and determining the facts.
3. Provide depth knowledge on codes of ethics.
4. Develop utilitarian thinking

UNIT IV

Engineers Responsibility for Safety and Risk: Safety and risk –Assessment of safety and risk –Risk benefit analysis and reducing risk-Safety and the Engineer-Designing for the safety-Intellectual Property rights (IPR).

Learning outcomes:

1. Create awareness about safety, risk & risk benefit analysis.
2. Engineer's design practices for providing safety.
3. Provide knowledge on intellectual property rights.

UINIT V

Global Issues: Globalization –Cross-culture issues-Environmental Ethics –Computer Ethics –Computers as the instrument of Unethical behavior –Computers as the object of Unethical acts –Autonomous Computers-Computer codes of Ethics –Weapons Development -Ethics and Research –Analyzing Ethical Problems in research.

Learning outcomes:

1. Develop knowledge about global issues.
2. Create awareness on computer and environmental ethics
3. Analyze ethical problems in research.
4. Give a picture on weapons development.

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Text Books:

1) "Engineering Ethics includes Human Values" by M.Govindarajan, S.Natarajan and, V.S.Senthil Kumar-PHI Learning Pvt. Ltd-2009
2) "Engineering Ethics" by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.
3) "Ethics in Engineering" by Mike W. Martin and Roland Schinzinger –Tata McGraw-Hill– 2003.
4) "Professional Ethics and Morals" by Prof.A.R.Aryasri, DharanikotaSuyodhana-Maruthi Publications.
5) "Professional Ethics and Human Values" by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran-LaxmiPublications.
6) "Professional Ethics and Human Values" by Prof.D.R.Kiran-

"Indian Culture, Values and Professional Ethics" by PSR Murthy-BS Publication

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	POWER SYSTEMS–II				

Preamble:
This course is an extension of power systems–I course. It deals with basic theory of transmission lines modeling and their performance analysis. Transient in power system, improvement of power factor and voltage control are discussed in detail. It is important for the student to understand the mechanical design aspects of transmission lines, cables, insulators. These aspects are also covered in detail in this course.

Learning Objectives:
- To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
- To study the short and medium length transmission lines, their models and performance.
- To study the performance and modeling of long transmission lines.
- To study the effect of travelling waves on transmission lines.
- To study the factors affecting the performance of transmission lines and power factor improvement methods.
- To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

UNIT–I:
Transmission Line Parameters
Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase and three phase– Single and double circuit lines– Concept of GMR and GMD–Symmetrical and asymmetrical conductor configuration with and without transposition–Bundled conductors – Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Capacitance calculations for symmetrical and asymmetrical single and three phase–Single and double circuit lines- Bundled conductors.

UNIT–II:
Performance Analysis of Transmission Lines
Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-Pie and A, B, C, D Constants for symmetrical and Asymmetrical Networks.

Rigorous Solution for long line equations – Surge Impedance and SIL of Long Lines – Representation of Long lines – Equivalent T and Equivalent Pie network models - Mathematical Solutions to estimate regulation and efficiency of all types of lines.

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UNIT – III:
Power System Transients
Types of System Transients – Travelling or Propagation of Surges – Attenuation–Distortion–Reflection and Refraction Coefficients – Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT–IV:
Various Factors governing the Performance of Transmission line
Skin and Proximity effects – Description and effect on Resistance of Solid Conductors –Ferranti effect – Charging Current – Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference.

UNIT–V:
Sag and Tension Calculations and Overhead Line Insulators
Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement - Voltage distribution–Calculation of string efficiency – Capacitance grading and Static Shielding.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand parameters of various types of transmission lines during different operating conditions.
- understand the performance of short and medium transmission lines.
- understand travelling waves on transmission lines.
- understand various factors related to charged transmission lines.
- understand sag/tension of transmission lines and performance of line insulators.

Text Books:
1. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers, 1998.
2. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2nd Edition

Reference Books:
1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai& Co Pvt. Ltd.
4. Electrical Power Systems by P.S.R. Murthy, B.S.Publications.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	POWER ELECTRONICS				

Preamble:
The usage of power electronics in day to day life has increased in recent years. It is important for student to understand the fundamental principles behind all these converters. This course covers characteristics of semiconductor devices, ac/dc, dc/dc, ac/ac and dc/ac converters. The importance of using pulse width modulated techniques to obtain high quality power supply (dc/ac converter) is also discussed in detail in this course.

Learning Objectives:
- To study the characteristics of various power semiconductor devices and to design firing circuits for SCR.
- To understand the operation of single phase full–wave converters and analyze harmonics in the input current.
- To study the operation of three phase full–wave converters.
- To understand the operation of different types of DC-DC converters.
- To understand the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- To analyze the operation of AC-AC regulators.

UNIT–I:
Introduction
Basic Theory of Operation - Static Characteristics-Two Transistors analogy -Turn on and Turn off Methods - Methods of SCR Triggering - Dynamic & Gate Characteristics of SCR - Series and Parallel Operation - Snubber circuit - Characteristics of Power MOSFET and IGBT.

UNIT–II:
Single Phase AC-DC Converters
Single Phase half wave controlled rectifiers - R load and RL load with and without freewheeling diode - Single Phase fully controlled bridge converter with R load, RL load and RLE load - Continuous and Discontinuous conduction - Effect of source inductance in 1-phase fully controlled bridge rectifier with continuous conduction – Expression for output voltages – Single Phase semi Converter with R load, RL load and RLE load – Continuous and Discontinuous conduction - Harmonic Analysis - Single Phase Dual Converters - Numerical Problems

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UNIT–III:
Three Phase AC-DC Converters & AC – AC Converters
Three Phase half wave Rectifier with R and RL load -Three Phase fully controlled rectifier with R and RL load - Three Phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three Phase Dual Converters - Numerical Problems.

AC-AC power control by phase control with R and RL loads - Three phase AC voltage regulator with R load – Single phase step down Cycloconverter - Numerical Problems.

UNIT–IV:
DC–DC Converters
Operation of Basic Chopper - Classification - Control Techniques - Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple- Numerical Problems.

UNIT – V:
DC–AC Converters
Introduction - Classification - Single Phase half bridge and full bridge inverters with R and RL loads - Unipolar & Bipolar Switching - Quasi-square wave pulse width modulation - Three Phase square wave inverters - 120^0 conduction and 180^0 conduction modes of operation - PWM inverters - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Learning Outcomes:
After the completion of the course the student should be able to:
- explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR's.
- design firing circuits for SCR.
- explain the operation of single phase full–wave converters and analyze harmonics in the input current.
- explain the operation of three phase full–wave converters.
- analyze the operation of different types of DC-DC converters.
- explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- analyze the operation of AC-AC regulators.

Text Books:
1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.

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2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics–Philip T.Krein.oxford.
2. Power Electronics – by P.S.Bhimbra, Khanna Publishers.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New   Age International (P) Limited Publishers, 1996.
4. Power Electronics: by Daniel W.Hart, Mc Graw Hill.

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	LINEAR IC APPLICATIONS				

Preamble:

To understand the various possible applications of integrated circuits this course is proposed. To attend this course, it is assumed that all the students taking this course should have the basic electronic circuits' concepts. In the course content, basic characteristics required to use integrated circuits for various applications are included, followed by the linear and nonlinear applications of operational amplifiers. In addition, application of integrated circuits in filter design, modulators, analog multiplier, timer and phase locked loops applications. Application of integrated circuits for analog-to-digital and digital-to-analog conversion is also included.

Learning Objectives:
- To understand the basic operation &performance parameters of differential amplifiers.
- To understand & learn the measuring techniques of performance parameters of Op-Amp
- To learn the linear and non-linear applications of operational amplifiers.
- To understand the analysis & design of different types of active filters using Op-Amps
- To learn the internal structure, operation and applications of different analog ICs
- To Acquire skills required for designing and testing integrated circuits

UNIT I
Characteristics of OP-Amps:
Characteristics of OP-Amps, Integrated circuits-Types, Classification, Package Types and Temperature ranges, Power supplies, Op-Amp Block Diagram, ideal and practical Op-amp Specifications, DC and AC characteristics, 741 op-amp & its features, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, slew rate, CMRR, PSRR, drift, Frequency Compensation techniques.

UNIT II
Linear And Non-Linear Applications Of Op-Amps:
Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non- Linear function generation, Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti log Amplifiers, Precision rectifiers.

UNIT III

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Active Filters, Analog Multipliers And Modulators:
 Design & Analysis of Butterworth active filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and all pass filters.
Four Quadrant Multiplier, IC 1496, Sample & Hold circuits.

UNIT IV
Timers & Phase Locked Loops:
Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger; PLL - introduction, block schematic, principles and description of

individual blocks, 565 PLL, Applications of PLL – frequency multiplication, frequency translation, AM, FM & FSK demodulators. Applications of VCO (566).

UNIT V
Digital To Analog And Analog To Digital Converters:
Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs – parallel Comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC.DAC and ADC Specifications, Specifications AD 574 (12 bit ADC).

Learning Outcomes:
After the completion of the course the student should be able to:
- design circuits using operational amplifiers for various applications.
- analyze and design amplifiers and active filters using Op-amp.
- diagnose and trouble-shoot linear electronic circuits.
- understand the gain-bandwidth concept and frequency response of the amplifier configurations.
- understand thoroughly the operational amplifiers with linear integrated circuits.

Text Books:
1. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
2. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.
3. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

References Books:
1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons;2nd Edition,2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.

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3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition

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III Year – I SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL SIGNAL PROCESSING				

Preamble:
The course has been designed to cater to the needs of electronic industry transforms. This course covers basic concepts of signal processing, various transformation techniques. It provides students to relies about different filter structure and also coding of speech signals.

Learning Objectives:

- To explore the basic concepts of digital signal processing.
- To connect the time domain signal to frequency domain signals using fourier transform.
- To understand the basic structures of IRR systems.
- To understand and design FIR Digital filters.
- To explore the concepts of multiple sampling rates for DSP.

UNIT-I:
Introduction
Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, Invertability, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.

UNIT-II:
Discrete Fourier Series & Fourier Transforms
Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.

UNIT-III:
Design of IIR Digital Filters& Realizations
Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

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UNIT-IV:
Design of FIR Digital Filters & Realizations
Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters.
Basic structures of FIR systems, Lattice structures, Lattice-ladder structures
UNIT-V:
Multirate Digital Signal Processing
Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters, Applications – Sub-band Coding of Speech Signals, Implementation of Digital Filter Banks, Trans-multiplexers.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the concepts of signal processing& transforms.
- appraise the Fat Fourier algorithm.
- design FIR and IIR filters.
- appreciate the concepts of multirate signal processing.

Text Books:

1. Digital Signal Processing, Principles, Algorithms, and Applications: John G. Proakis Dimitris G.Manolakis, Pearson Education / PHI, 2007.
2. Discrete Time Signal Processing – A.V.Oppenheim and R.W. Schaffer, PHI.
3. Digital Signal Processing – K Raja Rajeswari, I.K. International Publishing House.

Reference Books:

1. Digital Signal Processing: Andreas Antoniou, TATA McGraw Hill , 2006
2. Digital Signal Processing: MH Hayes, Schaum's Outlines, TATA Mc-Graw Hill, 2007.
3. DSP Primer - C. Britton Rorabaugh, Tata McGraw Hill, 2005.
4. Fundamentals of Digital Signal Processing using Matlab – Robert J. Schilling, Sandra L. Harris,Thomson, 2007.
5. Digital Signal Processing – Alan V. Oppenheim, Ronald W. Schafer, PHI Ed., 2006

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		L	T	P	C
III Year – I SEMESTER		3	0	0	3
	MICROPROCESSORS AND MICROCONTROLLERS				

Preamble:
Microprocessor and Microcontroller have become important building blocks in digital electronics design. It is important for student to understand the architecture of a microprocessor and its interfacing with various modules. 8086 microprocessor architecture, programming, and interfacing is dealt in detail in this course. Interfacing, PIC, architecture, programming in C.

Learning objectives:
- To understand the organization and architecture of Microprocessor
- To understand addressing modes to access memory
- To understand 8051 micro controller architecture
- To understand the programming principles for 8086 and 8051
- To understand the interfacing of MP with IO as well as other devices
- To understand how to develop cyber physical systems

UNIT–I:
Introduction to Microprocessor Architecture
Introduction and evolution of Microprocessors – Architecture of 8086 – Memory Organization of 8086 – Register Organization of 8086 – Instruction sets of 8086 – Addressing modes – Assembler directives – Introduction to 80286, 80386, 80486 and Pentium (brief description about architectural advancements only).

UNIT–II:
Minimum and Maximum Mode Operations
General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

Microprocessors I/O interfacing – I
8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086.

UNIT–III:

Microprocessors I/O interfacing – II
Architecture and interfacing of 8251 USART – Architecture and interfacing of 8254 Timer/counter – Architecture and interfacing of DMA controller (8257) – Architecture 8259 Programmable Interrupt Controller (8259) – Command words and operating modes of 8259 –

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Interfacing of 8259 – Architecture of Keyboard/display controller (8279) – Modes of operation – Command words of 8279 – Interfacing of 8279.

UNIT–IV:
8051 Microcontroller:
Overview of 8051 Microcontroller – Architecture– Memory Organization – Register set – I/O ports and Interrupts – Timers and Counters – Serial Communication – Interfacing of peripherals-Instruction set.

UNIT– V:
PIC Architecture
Block diagram of basic PIC 18 micro controller – registers I/O ports – Programming in C for PIC: Data types, I/O programming, logical operations, data conversion.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the Microprocessor capability in general and explore the evaluation of microprocessors.
- understand the addressing modes of Microprocessors
- understand the Microcontroller capability
- program Microprocessors and Microcontrollers.
- interface Microprocessors and Microcontrollers with other electronic devices
- develop cyber physical systems

Text Books:
1. Ray and Burchandi, "Advanced Microprocessors and Interfacing", Tata McGraw–Hill.
2. Kenneth J Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition.
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18, - Muhammad Ali Mazidi, RolindD.Mckinay , Danny causey -Pearson Publisher 21st Impression.

Reference Books:
1. Microprocessors and Interfacing, Douglas V Hall, Mc–Graw Hill, 2nd Edition.
2. R.S. Kaler, " A Text book of Microprocessors and Micro Controllers", I.K. International Publishing House Pvt. Ltd.
3. Ajay V. Deshmukh, "Microcontrollers – Theory and Applications", Tata McGraw–Hill Companies –2005.
4. Ajit Pal, "Microcontrollers – Principles and Applications", PHI Learning Pvt Ltd, 2011.

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III Year – I SEMESTER		L	T	P	C
		0	0	3	1.5
	ELECTRICAL MACHINES – II LABORATORY				

Learning objectives:
- To control the speed of three phase induction motors.
- To determine /predetermine the performance three phase and single phase induction motors.
- To improve the power factor of single phase induction motor .
- To predetermine the regulation of three–phase alternator by various methods, find X_d/ X_q ratio of alternator and asses the performance of three–phase synchronous motor.

Any 10 of the following experiments are to be conducted:
1. Brake test on three phase Induction Motor
2. No–load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance &m.m.f. Methods
4. Regulation of three–phase alternator by Potier triangle method
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.
10. Power factor improvement of single-phase induction motor by using capacitors and load test on single-phase induction motor.
11. Parallel operation of three-phase alternator.
12. Brake test on single-phase AC series Motor.
13. Starting methods of a capacitor start and capacitor start run single-phase Induction motor.
14. Brake test on single-phase Induction Motor.

Learning outcomes:
After the completion of the course the student should be able to:
- assess the performance of single phase and three phase induction motors.
- control the speed of three phase induction motor.
- predetermine the regulation of three–phase alternator by various methods.
- find the X_d/ X_q ratio of alternator and asses the performance of three–phase synchronous motor.
- determine the performance single phase AC series motor.

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COURSE STRUCTURE-R19

III Year – I SEMESTER		L	T	P	C
		0	0	2	1
CONTROL SYSTEMS LABORATORY					

Learning Objectives:
- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchros.
- To understand time and frequency responses of control system with and without controllers and compensators.

Any 10 of the following experiments are to be conducted:
1. Time response of Second order system
2. Characteristics of Synchros
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag and lead compensation – Magnitude and phase plot
5. Transfer function of DC motor
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5th order using MATLAB.
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor
11. Characteristics of DC servo motor
12. Block Diagram Representation of Field Controlled DC servo Motor Using Simulink.

Learning Outcomes:
After the completion of the course the student should be able to:
- analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors and synchros.
- design P,PI,PD and PID controllers
- design lag, lead and lag–lead compensators
- control the temperature using PID controller
- determine the transfer function of D.C Motor
- control the performance of D.C and A.C Servo Motor.
- test the controllability and observability.
- judge the stability in time and frequency domain.

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III Year – I SEMESTER		L	T	P	C
		0	0	3	1.5

ELECTRICAL MEASUREMENTS & INSRUMENTATION LABORATORY

Learning Objectives:

- To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
- To understand the calibration of DC and AC Potentiometers.
- To understand the testing of CT and PT.
- To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer.
- To understand the measurement of strain, Phase difference and frequency.

Any 10 of the following experiments are to be conducted

1. Calibration of dynamometer wattmeter using phantom loading
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance.
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Measurement of 3 phase power with single watt meter and 2 No's of C.T.
8. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
10. AC Potentiometer – Polar form/Cartesian form – Calibration of AC Voltmeter, Parameters of Choke
11. Thermocouple – characteristics
12. LVDT – characteristics.
13. Capacitive transducers characteristics.
14. Piezoelectric transducer characteristics.
15. Measurement of strain using strain gauge
16. Measurement of phase difference, frequency using Lissajous patterns in CRO.

Learning Outcomes:

After the completion of the course the student should be able to:

- measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
- known the characteristics of transducers.
- measure the strains, frequency and phase difference.

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COURSE STRUCTURE-R19

III Year – I SEMESTER		L	T	P	C
		0	0	1	1
SOCIALLY RELAVENT PROJECTS					

Preamble:

There is lot of scientific and technological changes in the nation during last few decades in almost all the sectors. The state and central governments are introducing many schemes to all classes of people of the nation to increase the productivity in various sectors. India is a rural centric nation and the fruits of the scientific inventions and new technology shall be shared among all remote corners of the nation. With this aim, a socially relevant project is newly introduced in the curriculum with an objective of taking up the projects relevant to the societal needs.

Objectives:

(1) The student(s) shall explore the technological needs of society

(2) The student(s) shall understand the technological problems of society

General guidelines:

- A socially relevant project shall be a community service based project and it shall be innovative.
- A student has to pursue the socially relevant project to solve real life and pressing problems of society.
- The pursued socially relevant projects shall contribute to national development goals and priorities.
- Socially relevant project can be carried out by an individual student or by a team of maximum 5 of concerned department.
- The student(s) shall visit the society (Villages/Hospitals/Social Service Organizations etc) to identify the problem and conduct literature survey and provide a feasible solution.
- The socially relevant project selected shall be in the broad area of concerned discipline of course. Preference shall be given to rural societal problems.
- Each team shall work under the supervision of a faculty member of the concerned department.
- If the course is offered in II Year I Semester, the student or team of students shall complete this project during the vacation after I Year and so on.
- The duration of the project is about 15 to 20 hrs in total and students may split total duration into 2 to 3 hrs per day based convenience. The attendance shall be maintained by the supervisor.

Sample Projects (but not limited to):

(i) Energy Auditing in a rural village (ii) Smart starting and control of motors in agriculture and aqua fields (iii) TV Remote Operated Domestic Appliances Control (iv) Solar Powered Auto Irrigation System (v) Auto Intensity Control of Street Lights (vi) Hidden Active Cell Phone Detector (vii) Railway Track Security System (viii) Solar

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COURSE STRUCTURE-R19

Power Charge Controller (ix) Home Automation System Using Digital Control (x) Intelligent Overhead Tank Water Level Indicator (xi) Pre Stampede Monitoring and Alarm System (xii) Detect Rash Driving Speed Checker System on Highways

Outcomes

 (1) The student(s) are be able to provide a solutions the technological problems of society

 (1) The student(s) is able suggest technological changes which suits current needs of society

(2) The student(s) are able to explain new technologies available for problems of the society.

Reference:

(1) Web Link: http://iitk.ac.in/new/socially-relevant-research

(2) https://csie.iitm.ac.in/SocialProjectsIITM.html

(3) http://www.iitkgp.ac.in/files/csr/csr_education.pdf

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRIC DRIVES				

Preamble:

This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters that are used in industry. It is equally important to understand the four quadrant operation of electric drives and slip power recovery schemes in induction motors.

Learning Objectives:

- To learn the fundamentals of electric drive and different electric braking methods.
- To analyze the operation of three phase converter controlled dc motors and four quadrant operation of dc motors using dual converters.
- To discuss the converter control of dc motors in various quadrants.
- To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- To learn the principles of static rotor resistance control and various slip power recovery schemes.
- To understand the speed control mechanism of synchronous motors

UNIT–I:

Fundamentals of Electric Drives

Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods**:** Dynamic – Plugging – Regenerative methods.

UNIT–II:

Controlled Converter Fed DC Motor Drives

1-phase half and fully controlled converter fed separately and self-excited DC motor drive – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems.

UNIT–III:

DC–DC Converters Fed DC Motor Drives

Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation – Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics – Four quadrant operation – Closed loop operation (qualitative treatment only).

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UNIT–IV:
Stator side control of 3-phase Induction motor Drive
Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop v/f control of induction motor drives (qualitative treatment only).

UNIT–V:
Rotor side control of 3-phase Induction motor Drive & Synchronous Motor Drives
Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

Separate control of synchronous motor – self control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive – PMSM (Basic operation only).

Learning Outcomes:
After the completion of the course the student should be able to:
- explain the fundamentals of electric drive and different electric braking methods.
- analyze the operation of three phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
- describe the converter control of dc motors in various quadrants of operation
- know the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters.
- differentiate the stator side control and rotor side control of three phase induction motor, explain the speed control mechanism of synchronous motors.

Text Books:
1. Fundamentals of Electric Drives – by G K Dubey, Narosa Publications
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition.

Reference Books:
1. Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.
2. Thyristor Control of Electric drives – VedamSubramanyam Tata McGraw Hill Publications.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3

POWER SYSTEM ANALYSIS

Preamble:
The course is designed to give students the required knowledge for the design and analysis of electrical power grids. Calculation of power flow in a power system network using various techniques, formation of Z_{bus} and its importance are covered in this course. It also deals with short circuit analysis and analysis of power system for steady state and transient stability.

Learning Objectives:
- To development the impedance diagram (p.u) and formation of Y_{bus}
- To study the different load flow methods.
- To study the concept of the Z_{bus} building algorithm.
- To study short circuit calculation for symmetrical faults
- To study the effect of unsymmetrical faults and their effects.
- To study the rotor angle stability of power systems.

UNIT –I:
Circuit Topology & Per Unit Representation
Graph theory definition – Formation of element node incidence and bus incidence matrices – Primitive network representation – Formation of Y_{bus} matrix by singular transformation and direct inspection methods - Per Unit Quantities–Single line diagram– Impedance diagram of a power system.

UNIT –II:
Power Flow Studies
Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods – Algorithmic approach –Problems on 3–bus system only.

UNIT – III:
Z-Bus Algorith & Symmetrical Fault Analysis:
Formation of Z_{bus}**:** Algorithm for the Modification of Z_{bus} Matrix (without mutual impedance).

Symmetrical Fault Analysis:
Reactances of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems.

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UNIT –IV:
Symmetrical Components & Fault analysis
Definition of symmetrical components - symmetrical components of unbalanced three phase systems – Power in symmetrical components – Sequence impedances: Synchronous generator – Transmission line and transformers – Sequence networks –Various types of faults LG– LL– LLG and LLL on unloaded alternator–unsymmetrical faults on power system for numerical problems only.

UNIT – V:
Power System Stability Analysis
Elementary concepts of Steady state – Dynamic and Transient Stabilities – Description of Steady State Stability Power Limit –Transfer Reactance–Synchronizing Power Coefficient – Power Angle Curve and Determination of Steady State Stability – Derivation of Swing Equation–Determination of Transient Stability by Equal Area Criterion –Applications of Equal Area Criterion – Methods to improve steady state and transient stability.

`Learning Outcomes:
After the completion of the course the student should be able to:
- draw impedance diagram for a power system network and to understand per unit quantities.
- form a Y_{bus} and Z_{bus} for a power system networks.
- understand the load flow solution of a power system using different methods.
- find the fault currents for all types faults to provide data for the design of protective devices.
- find the sequence components of currents for unbalanced power system network.
- analyze the steady state, transient and dynamic stability concepts of a power system.

Text Books:
1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company, 2nd edition.

Reference Books:
1. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
2. Power System Analysis by HadiSaadat – TMH Edition.
3. Power System Analysis by B.R.Gupta, Wheeler Publications.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – Cengage Learning publications.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DATA STRUCTURES				

Preamble:
This course is core subject developed to help the student understand the data structure principles used in power systems, machines and control systems. This subject covers linear data structures, linked lists, trees, graphs, searching and sorting.

Course Objectives:
- Operations on linear data structures and their applications.
- The various operations on linked lists.
- The basic concepts of Trees, Traversal methods and operations.
- Concepts of implementing graphs and its relevant algorithms.
- Sorting and searching algorithms.

Unit-1:
Linear Data Structures: Arrays, Stacks And Queues
Data Structures -Operations-Abstract Data Types-Complexity of Algorithms-Time and Space-Arrays-Representation of Arrays-Linear Arrays-Insertion–Deletion and Traversal of a Linear Array-Array as an Abstract Data Type-Multi-Dimensional arrays-Strings-String Operations-Storing Strings-String as an Abstract Data Type

Stack -Array Representation of Stack-Stack Abstract Data Type-Applications of Stacks: Prefix-Infix and Postfix Arithmetic Expressions-Conversion-Evaluation of Postfix Expressions-Recursion-Towers of Hanoi-Queues-Definition-Array Representation of Queue-The Queue Abstract Data Type-Circular Queues-Dequeues-Priority Queues.

Unit-II:
Linked Lists
Pointers-Pointer Arrays-Linked Lists-Node Representation-Single Linked List-Traversing and Searching a Single Linked List-Insertion into and Deletion from a Single Linked List-Header Linked Lists-Circularly Linked Lists-Doubly Linked Lists-Linked Stacks and Queues-Polynomials-Polynomial Representation-Sparse Matrices.

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Unit-III:
Trees
Terminology-Representation of Trees-Binary Trees-Properties of Binary Trees-Binary Tree Representations-Binary Tree Traversal-Preorder-Inorder and Postorder Traversal-Threads-Thread Binary Trees-Balanced Binary Trees-Heaps-Max Heap-Insertion into and Deletion from a Max Heap-Binary Search Trees-Searching-Insertion and Deletion from a Binary Search Tree-Height of Binary Search Tree, m-way Search Trees, B-Trees.

Unit-IV:
Graphs
Graph Theory Terminology-Graph Representation-Graph Operations-Depth First Search-Breadth First Search-Connected Components-Spanning Trees-Biconnected Components-Minimum Cost Spanning Trees-Kruskal's Algorithm-Prism's Algorithm-Shortest Paths-Transitive Closure-All-Pairs Shortest Path-Warshall's Algorithm.

Unit-V:
Searching And Sorting
Searching -Linear Search-Binary Search-Fibonacci Search-Hashing-Sorting-Definition-Bubble Sort-Insertion sort-Selection Sort-Quick Sort-Merging-Merge Sort-Iterative and Recursive Merge Sort-Shell Sort-Radix Sort-Heap Sort.

Course Outcomes:
After the completion of the course the student should be able to:
- data structures concepts with arrays, stacks, queues.
- linked lists for stacks, queues and for other applications.
- traversal methods in the Trees.
- various algorithms available for the graphs.
- sorting and searching in the data ret retrival applications.

Text Books:

1. Fundamentals of Data Structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson Freed, Universities Press Pvt. Ltd.
2. Data Structures With C, Seymour Lipschutz, Schaum's Outlines, Tata McGraw Hill.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL CONTROL SYSTEMS				

Preamble:
In recent years digital controllers have become popular due to their capability of accurately performing complex computations at high speeds and versatility in leading nonlinear control systems. In this context, this course focuses on the analysis and design of digital control systems.

Learning objectives:
- To understand the concepts of digital control systems and assemble various components associated with it. Advantages compared to the analog type.
- The theory of z–transformations and application for the mathematical analysis of digital control systems.
- To represent the discrete–time systems in state–space model and evaluation of state transition matrix, the design of state feedback control by "the pole placement method.", design of state observers.
- To examine the stability of the system using different tests.
- To study the conventional method of analyzing digital control systems in the w–plane.

UNIT – I:
Introduction and signal processing
Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Continuous and Discrete Time Signals – Sample and hold devices – Sampling theorem and data reconstruction – Frequency domain characteristics of zero order hold.

UNIT–II:
z–transformations
z–Transforms – Theorems – Finding inverse z–transforms – Formulation of difference equations and solving – Block diagram representation – Pulse transfer functions and finding open loop and closed loop responses.

UNIT–III:
State space analysis and the concepts of Controllability and observability
State space representation of discrete time systems – Solving Discrete Time state space equations – State transition matrix and its properties – Discretization of continuous time state equations – Concepts of controllability and observability – Tests(without proof).

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State Feedback Controllers and State Observers
Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula – Design of state observers (Full Order and Reduced Order).

UNIT – IV:
Stability analysis
Mapping between the s–Plane and the z–Plane – Primary strips and Complementary strips – Stability criterion – Modified Routh's stability criterion and Jury's stability test.

UNIT – V:
Design of discrete–time control systems by conventional methods
Transient and steady state specifications – Design using frequency response in the w–plane for lag and lead compensators – Root locus technique in the z–plane.

Learning outcomes:
After the completion of the course the student should be able to:
- learn the advantages of discrete time control systems and the "know how" of various associated accessories.
- understand z–transformations and their role in the mathematical analysis of different systems(like Laplace transforms in analog systems).
- learn the stability criterion for digital systems and methods adopted for testing the same are explained.
- understand the conventional and state space methods of design are also introduced.

Text Book:
1. Discrete–Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. Digital Control and State Variable Methods by M.Gopal, TMH, 4th Edition.

Reference Books:
1. Digital Control Systems, Kuo, Oxford University Press, 2nd Edition, 2003.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	DIGITAL IC APPLICATIONS **(ELECTIVE-I)**				

Preamble:

This course introduces digital logic families and interfacing concepts for digital design and introduces VHDL fundamentals to model digital system design blocks. Behavioral modeling of digital circuits is discussed. Design and implementation of combinational, synchronous and asynchronous sequential digital logic circuits are introduced.

Learning Objectives:

- Introduction of digital logic families and interfacing concepts for digital design is considered.
- VHDL fundamentals were discussed to modeling the digital system design blocks.
- VHDL compilers, simulators and synthesis tools are described, which are used to verify digital systems in a technology-independent fashion.
- Design and implementation of combinational and sequential digital logic circuits is explained.

UNIT-I:
Digital Logic Families, Interfacing and Introduction to VHDL
Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic.
Design flow, program structure, levels of abstraction, Elements of VHDL: Data types, data objects, operators and identifiers. Packages, Libraries and Bindings, Subprograms. VHDL Programming using structural and data flow modeling.

UNIT-II:
Behavioral Modeling
Process statement, variable assignment statement, signal assignment statement, wait statement , if statement, case statement ,null statement, loop statement, exit statement, next statement ,assertion statement, more on signal assignment statement ,Inertial Delay Model, Transport Delay Model ,Creating Signal Waveforms, Signal Drivers , Other Sequential Statements , Multiple Processes. Logic Synthesis, Inside a logic Synthesizer.

UNIT-III:
Combinational Logic Design
Binary Adder-Subtractor, Ripple Adder, Look Ahead Carry Generator, ALU, Decoders, encoders, multiplexers and demultiplexers, parity circuits, comparators, Barrel Shifter, Simple

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Floating-Point Encoder, Dual Priority Encoder, Design considerations of the above combinational logic circuits with relevant Digital ICs, modeling of above ICs using VHDL.

UNIT-IV
Sequential Logic Design
SSI Latches and flip flops, Ring Counter, Johnson Counter, Design of Modulus N Synchronous Counters, Shift Registers, Universal Shift Registers, Design considerations of the above sequential logic circuits with relevant Digital ICs, modeling of above ICs using VHDL.

UNIT-V:
Synchronous and Asynchronous Sequential Circuits
Basic design steps: State diagram, state table, state assignment, choice of flip flops and derivation of next state and output expressions, timing diagram. State assignment problem: One hot encoding. Mealy and Moore type FSM for serial adder, VHDL code for the serial adder. Analysis of Asynchronous circuits, State Reduction, State Assignment. A complete design example: The vending machine controller.

Learning Outcomes:
After the completion of the course the student should be able to:
* understand the structure of commercially available digital integrated circuit families.
* learn the IEEE Standard 1076 Hardware Description Language (VHDL).
* model complex digital systems at several levels of abstractions, behavioral, structural, simulation, synthesis and rapid system prototyping.
* analyze and design basic digital circuits with combinatorial and sequential logic circuits using VHDL.

Text Books:

1. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 3rd Ed., 2005.
2. VHDL Primer – J. Bhasker, Pearson Education/ PHI, 3rd Edition.

References:

1. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGrawHill, 3rd Edition.

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COURSE STRUCTURE-R19

		L	T	P	C
III Year – II SEMESTER		**3**	**0**	**0**	**3**
	COMMUNICATION SYSTEMS				

Preamble:
Awareness on the concepts and working of communication blocks is inevitable for an electrical engineering student to excel in smart grid applications.
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Learning Objectives:
- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques.
- To get introduced to the basics of error control coding techniques.

Unit – I:
Basic blocks of Communication System. Analog Modulation - Principles of Amplitude Modulation, DSBSC, SSB-SC and VSB-SC, AM transmitters and receivers.

Unit- II:
Angle Modulation - Frequency and Phase Modulation. Transmission Bandwidth of FM signals, Methods of generation and detection, FM Transmitters and Receivers.

Unit–III:
Sampling theorem - Pulse Modulation Techniques - PAM, PWM and PPM concepts - PCM system – Data transmission using analog carriers (BASK, BFSK, BPSK, QPSK).

UNIT IV:
Error control coding techniques – Linear block codes- Encoder and decoder, Cyclic codes – Encoder, Syndrome Calculator, Convolution codes.

UNIT V:
Modern Communication Systems – Microwave communication systems - Optical communication system - Satellite communication system - Mobile communication system.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the basics of communication system, analog and digital modulation techniques.

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- apply the knowledge of digital electronics and understand the error control coding techniques.
- summarize different types of communication systems and its requirements.

Text Books:
1. Simon Haykins, 'Communication Systems', John Wiley, 3rd Edition, 1995.
2. D.Roddy & J.Coolen, 'Electronic Communications', Prentice Hall of India, 4th Edition, 1999.
3. Kennedy G, 'Electronic Communication System', McGraw Hill, 1987.

Reference Books:
1. Shulin Daniel, 'Error Control Coding', Pearson, 2nd Edition, 2011.
2. B.P. Lathi and Zhi Ding, 'Modern Digital and Analog Communication Systems', OUP USA Publications, 4th Edition, 2009.

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	COMPUTER NETWORKS **(ELECTIVE-I)**				

Preamble:
This course is designed to impart the knowledge in computer networks used for data transmission through internet. The topics covered in this subject are LAN, WAN, TCP/ICP models, Digital modulation and multiplexing, Layers of computer networks, Protocol, Routing algorithms, etc.

Learning Objectives:
- Understand state-of-the-art in network protocols, architectures, and applications.
- Process of networking research
- Constraints and thought processes for networking research
- Problem Formulation—Approach—Analysis—

UNIT – I:
INTRODUCTION COMPUTER NETWORKS:
Network Topologies WAN, LAN, MAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models

Physical Layer – Fourier Analysis – Bandwidth Limited Signals – The Maximum Data Rate of a Channel - Guided Transmission Media, Digital Modulation and Multiplexing: Frequency Division Multiplexing, Time Division Multiplexing, Code Division Multiplexing
Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols

UNIT – II:
THE DATA LINK LAYER: Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction – Error-Correcting Codes – Error Detecting Codes, Elementary Data Link Protocols- A Utopian Simplex Protocol-A Simplex Stop and Wait Protocol for an Error free channel-A Simplex Stop and Wait Protocol for a Noisy Channel, Sliding Window Protocols-A One Bit Sliding Window Protocol-A Protocol Using Go-Back-N- A Protocol Using Selective Repeat

UNIT – III:
MEDIUM ACCESS CONTROL SUBLAYER-The Channel Allocation Problem-Static Channel Allocation-Assumptions for Dynamic Channel Allocation, Multiple Access Protocols-

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Aloha-Carrier Sense Multiple Access Protocols-Collision-Free Protocols-Limited Contention Protocols-Wireless LAN Protocols, Ethernet-Classic Ethernet Physical Layer-Classic Ethernet MAC Sublayer Protocol-Ethernet Performance-Fast Ethernet Gigabit Ethernet-10-Gigabit Ethernet-Retrospective on Ethernet, Wireless Lans-The 802.11 Architecture and Protocol Stack-The 802.11 Physical Layer-The802.11 MAC Sublayer Protocol-The 805.11 Frame Structure-Services

UNIT – IV:
DESIGN ISSUES-The Network Layer Design Issues – Store and Forward Packet Switching-Services Provided to the Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service-Comparison of Virtual Circuit and Datagram Networks, Routing Algorithms-The Optimality principle-Shortest path Algorithm, Congestion Control Algorithms-Approaches to Congestion Control-Traffic Aware Routing-Admission Control-Traffic Throttling-Load Shedding.

UNIT – V:
TRANSPORT LAYER: The Internet Transport Protocols: Udp, the Internet Transport Protocols: TCP Application Layer –The Domain Name System: The DNS Name Space, Resource Records, Name Servers, Electronic Mail: Architecture and Services, The User Agent, Message Formats, Message Transfer, Final Delivery

Learning Outcomes:
After the completion of the course the student should be able to:
- understand OSI and TCP/IP models
- analyze MAC layer protocols and LAN technologies
- design applications using internet protocols
- understand routing and congestion control algorithms
- understand how internet works

Text Books:
1. Tanenbaum and David J Wetherall, Computer Networks, 5th Edition, Pearson Edu, 2010
2. Computer Networks: A Top Down Approach, Behrouz A. Forouzan, FirouzMosharraf, McGraw Hill Education

Reference Books:
1. Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed), Morgan Kaufmann/ Elsevier, 2011

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3

INTERNET OF THINGS APPLICATIONS TO ELECTRICAL ENGINEERING
(ELECTIVE-I)

Preamble:
Importance to the development of miniature devices for monitoring and sensing of data using internet is increasing day by day. In view of this, to give an insight about these technologies to the students of electrical engineering this course in designed. In this course, introduction to Internet of Things, various architectures of IoT, Communication protocols are introduced. In addition, data acquisition, data communication, introduction to data analytics, sensors and actuators are also presented. To give a view about the IoT implementations, few case studies about Smart Home, Smart Cities, Environment monitoring and smart agriculture practices are also presented.

Learning Objectives:
- To understand fundamentals, architecture and various technologies of Internet of Things.
- To know various communication technologies used in the Internet of Things.
- To know the connectivity of devices using web and internet in the IoT environment.
- To know various data acquisition methods, data handling using cloud for IoT applications.
- To understand the implementation of IoT by studying case studies like Smart Home, Smart city, etc.

UNIT - I:
The Internet of Things: An Overview of Internet of Things (IoT) – IoT framework – Architecture – Technology behind IoT – Sources of the IoT – M2M Communication – Examples ofIoT.

UNIT – II:
Design Principles For Connected Devices: Introduction –IoT/M2M systems, Layers and Designs Standardization – Communication Technologies – Data Enrichment, Consolidation and Device Management at Gateway – Ease of designing and affordability.

UNIT – III:
Design Principles for the Web Connectivity: Introduction – Web Communication protocols for Connected Devices - Message Communication protocols for Connected Devices – Web Connectivity for connected devices network.

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COURSE STRUCTURE-R19

Introduction to Internet Connectivity Principles, Internet connectivity, Internet based communication – IP addressing in the IoT – Application Layer Protocols: HTTP, HTTPS, FTP, Telnet, WAP (Wireless Application Protocol).

UNIT–IV:
Data Acquiring, Organizing, Processing and Analytics: Introduction – Data Acquiring and Storage – Organizing the Data – Analytics.
Data Collection, Storage and Computing Using a Cloud Platform: Introduction – Cloud computing paradigm for data collection, storage and computing – IoTas a service and Cloud Service Models - IoT cloudbased services using the Xively (Pachube/COSM), Nimbits and other platforms.

UNIT– V:
Sensor technology: Actuator, Sensor data communication protocols, Radio Frequency Identification technology, Wireless Sensor Network Technology.
IoT application case studies: Smart Home, Smart Cities, Environment monitoring and Agriculture practices.

Learning Outcomes:
After the completion of the course the student should be able to:
- know the various fundamentals, architectures and technologies of Internet of Things.
- understand various communication technologies used in the Internet of Things.
- understand the various device connectivity methods using web and internet in the IoT environment.
- understand various data acquisition methods, data handling using cloud for IoT applications.
- know the implementation of IoT from the case studies like Smart Home, Smart city, etc.

Text Books:
1. Internet of Things: Architecture, Design Principles, Raj Kamal, McGraw Hill Education (India) Pvt. Limited, 2017.

Reference Books:
1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, First edition, 2013.
2. Getting Started with the Internet of Things, CunoPfister, O'reilly, 2011.
3. Internet of Things : A Hands-on Approach, ArshdeepBahga, and Vijay Madisetti, 2014.

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COURSE STRUCTURE-R19

III Year –II SEMESTER		L	T	P	C
		3	0	0	3
	VLSI DESIGN **(ELECTIVE-I)**				

Preamble:
This is an elective course designed to impart the knowledge in VLSI design principles. This course covers MOS devices and fabrication, CMOS logic circuits and applications of logic circuits.

Learning Objective:
- MOS and CMOS circuits features and characteristics.
- Fabrication principles of CMOS.
- Implementation of CMOS logic circuits.
- Memory design with CMOS family.
- Applications of CMOS circuits.

UNIT – I:
Introduction to MOS Devices
MOS characteristics: NMOS characteristics, inverter action – CMOS characteristics, inverter action - models and second order effects of MOS transistors – Current equation – MOSFET Capacitances - MOS as Switch, Diode/ resistor – current source and sink – Current mirror.

UNIT – II:
MOS Fabrication
CMOS Fabrication – n-well, p-well, twin-tub processes – fabrication steps – crystal growth – photolithography – oxidation – diffusion – Ion implantation – etching – metallization.

UNIT – III:
 CMOS Logic Circuits
CMOS Logic Circuits: Implementation of logic circuits using nMOS and CMOS, Pass transistor and transmission gates – Implementation of combinational circuits – parity generator – magnitude comparator – stick diagram – Design rules and layout design.

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UNIT – IV:
Higher order digital Logic Circuits
Memory design – SRAM cell – 6T SRAM – DRAM – 1T, 3T, 4T cells, CMOS Sequential circuits: Static and Dynamic circuits – True Single-phase clocked registers – Clocking schemes.

UNIT – V:
 Application Specific Integrated Circuits
ASIC - Types of ASICs - Design flow – Design Entry – Simulation – Synthesis – Floor planning – Placement – Routing - Circuit extraction – Programmable ASICs.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the insights of the MOS devices and its characteristics.
- appreciate the different VLSI process technologies.
- design the CMOS combinational logic circuits and its layout.
- develop the sequential circuits and clocking schemes.
- realize the Design flow of application-specific Integrated circuit.

Text Books:
1. Neil Weste, David Harris, 'CMOS VLSI Design: A Circuits and Systems Perspective', AddisonWesley, 4th Edition, 2020.
2. Debaprasad Das, 'VLSI Design', Oxford University Press, 2010.
3. Ken Martin, 'Digital Integrated Circuits', Oxford University Press, 1999.
4. Peter Van, 'Microchip Fabrication', Mc-Graw Hill Professional, 6th Edition, 2014.

Reference Books:
1. M. J. S. Smith, 'Application Specific Integrated Circuits', Addison Wesley, 1997.
2. Uyemura, 'Introduction to VLSI Circuits and Systems', Wiley, 1st Edition, 2012.

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III Year –II SEMESTER		L	T	P	C
		3	0	0	3
	CLOUD COMPUTING **(ELECTIVE-I)**				

Preamble:

This is an elective subject designed to known principles of clod computing. Inthis subject systems modeling, clustering, visualization, virtual machines, Data centres, Cloud architecture, cloud programming, resource management and scheduling and storage will be explained.

Learning Objectives:

- The cloud environment, building software systems.
- Components that scale to millions of users in modern internetcloud concepts capabilities across the various cloud service models including Iaas, Paas, Saas,
- Developing cloud based software applications on top of cloud platforms.

UNIT -I:

Systems modeling, Clustering and virtualization

Scalable Computing over the Internet, Technologies for Network based systems, System models for Distributed and Cloud Computing, Software environments for distributed systems and clouds, Performance, Security And Energy Efficiency

UNIT- II:

Virtual Machines and Virtualization of Clusters and Data Centers

Implementation Levels of Virtualization, Virtualization Structures/ Tools and mechanisms, Virtualization of CPU, Memory and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation.

UNIT- III:

Cloud Platform Architecture

Cloud Computing and service Models, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms, Inter Cloud Resource Management, Cloud Security and Trust Management. Service Oriented Architecture, Message Oriented Middleware.

Cloud Programming and Software Environments

Features of Cloud and Grid Platforms, Parallel & Distributed Programming Paradigms, Programming Support of Google App Engine, Programming on Amazon AWS and Microsoft Azure, Emerging Cloud Software Environments.

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UNIT-IV:
Cloud Resource Management and Scheduling
Policies and Mechanisms for Resource Management Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds. Coordination of Specialized Autonomic Performance Managers, Resource Bundling, Scheduling Algorithms for Computing Clouds, Fair Queuing, Start Time Fair Queuing, Borrowed Virtual Time, Cloud Scheduling Subject to Deadlines, Scheduling MapReduce Applications Subject to Deadlines.

UNIT- V:
Storage Systems
Evolution of storage technology, storage models, file systems and database, distributed file systems, general parallel file systems. Google file system. Apache Hadoop, Big Table, Megastore, Amazon Simple Storage Service (S3)

Learning Outcomes:
After the completion of the course the student should be able to:
- understanding the key dimensions of the challenge of Cloud Computing
- assessment of the economics , financial, and technological implications for selecting cloud computing for own organization
- assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
- assessment of own organizations' needs for capacity building and training in cloud computing-related IT areas

Text Books:
1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier.
3. Cloud Computing, A Hands on approach, ArshadeepBahga, Vijay Madisetti, University Press

Reference Books:
1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, TMH

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COURSE STRUCTURE-R19

III Year –II SEMESTER		L	T	P	C
		3	0	0	3
RENEWABLE ENERGY SOURCES **(OPEN ELECTIVE-I)**					

Preamble:
This course gives a flavor of renewable sources and systems to the students. It introduces solar energy its radiation, collection, storage and its applications. This covers generation, design, efficiency and characteristics of various renewable energy sources including solar, wind, hydro, biomass, fuel cells and geothermal systems.

Learning Objectives:
- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar photo voltaic systems.
- To study maximum power point techniques in solar pv and wind energy.
- To study wind energy conversion systems, Betz coefficient, tip speed ratio.
- To study basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

UNIT–I:
Fundamentals of Energy Systems and Solar energy
Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation**:** Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT–II:
Solar Photovoltaic Systems
Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System design**:** storage sizing – PV system sizing – Maximum power point tracking.

UNIT–III:
Wind Energy
Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

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UNIT–IV:
Hydro and Tidal power systems
Basic working principle – Classification of hydro systems**:** Large, small, micro – measurement of head and flow – Energy equation – Types of turbines – Numerical problems.
Tidal power – Basics – Kinetic energy equation – Turbines for tidal power - Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

UNIT–V:
Biomass, fuel cells and geothermal systems
Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.
Fuel cell**:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics.
Geothermal**:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

Learning Outcomes:
After the completion of the course the student should be able to:
- analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
- design solar photo voltaic systems.
- develop maximum power point techniques in solar PV and wind energy systems.
- explain wind energy conversion systems, wind generators, power generation.
- explain basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

Text Books:
1. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.
2. Non Conventional sources of Energy by G.D.Rai, Kanna Publications.

Reference Books:
1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
3. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
4. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
5. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
6. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
7. Non conventional energy source –B.H.khan- TMH-2nd edition.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
ESSENTIALS OF ANALOG AND DIGITAL ELECTRONICS **(OPEN ELECTIVE-I)**					

Preamble:

This is an open elective course designed to give the basic knowledge od analog and digital electronics to core engineering students. This course covers analog devices, digital components, signal generator circuits, decoders, programmable logic devices LCD, LED displays, Analog to Digital & Digital to Analog converters.

Learning Objectives:
- To understand the concepts of analog and digital devices & circuits.
- To understand signal generation circuits.
- To understand the digital & analog quantities and conversion from one to the other.
- To design and control LCD and LED displays.

UNIT -I

Review of Analog devices- Diode – P-N Diode- Zener Diode – V-I Characteristics - Rectifier Circuits –Wave Shaping Circuits – Clippers and Clampers – Zener regulator Circuits.
Op-amp –Inverting & non-inverting - Operation – Differentiator, integrator, precision rectifier, square waveform for generator, passive components – TTL, CMOS devices.

UNIT II

Oscillators & Signal generator circuits – Function generator circuit – Pulse generator circuit – AM/FM signal generator circuit – Qualitative analysis.

UNIT –III

Review of Digital components – Code converters: Binary to Gray Code – BCD to Seven segment decoder –Programmable Logic Devices: PROM, PAL, PLA. Sequential Logic: Latch & Flip flop, MOD- Counters – Shift Registers - Asynchronous 3-Bit Counter
.
UNIT -IV

Display Units – Optoelectronic devices –Seven segment displays – LCD and LED display units and applications –I^2C, SIP Protocol.

UNIT -V

Special electronic circuits- Schmitt trigger – Analog to Digital converter – Digital to Analog converter units.

Learning Outcomes:

After the completion of the course the student should be able to:

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- design and develop circuits using analog and digital components.
- understand the different generators and analyzers.
- appreciate the use of display units.
- design Analog to Digital and Digital to Analog Converters.

Text Books:

1. David A Bell, 'Fundamentals of Electronic Devices and Circuits', Oxford University Press, Incorporated, Recent Edition.
2. Kalsi H.S,'Electronic Instrumentaion', Tata McGraw-Hill Education, 3rd Edition, 2010.
3. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, Recent version..

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III Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL ESTIMATION AND COSTING (OPEN ELECTIVE-I)				

Preamble:
This course covers the topics on simple electrical connections design considerations of electrical installations and study of different types of electrical installations. It also covers the components of substations and various motor control circuits.

Learning Objectives:
- Introduce the electrical symbols and simple electrical circuits
- Able to learn the design of electrical installations.
- Able to learn the design of electrical installation for different types of buildings and small industries.
- Learn the basic components of electrical substations.
- Familiarize with the motor control circuits

UNIT -I:
Electrical Symbols and Simple Electrical Circuits
Need of electrical symbols, list of symbols, Electrical Diagrams, Methods of representation for wiring diagrams, introduction to simple light and fan circuits, system of connection of appliances and accessories, simple examples on light and fan circuits.

Unit-II:
Design Considerations of Electrical Installations
Electric supply system, Three-phase four wire distribution system, protection of electric installation against overload, short circuit and earth fault, earthing, neutral and earth wire, types of loads, systems of wiring, permissible of voltage drops and sizes of wires , estimating and costing of electrical installations

Unit-III:
Electrical Installation for Different Types of Buildings and Small Industries
Electrical installations for electrical buildings, estimating and costing of material, simple examples on electrical installation for residential buildings, electrical installations for commercial buildings, electrical installation for small industries

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Unit-IV:
Substations
Introduction, types of substations, outdoor substations-pole mounted type, indoor substations-floor mounted type, simple examples on quantity estimation.

Unit-V: Motor control circuits
Introduction to AC motors, starting of three phase squirrel cage induction motors, starting of wound rotor motors, starting of synchronous motors, contractor control circuit components, basic control circuits, motor protection

Learning Outcomes:
After the completion of the course the student should be able to:
- identify the various electrical apparatus and their interconnections.
- select suitable electrical supply system and design earthing systems of various electric loads.
- estimate the cost for installation of wiring for different types of building and small industries.
- identify the components of electrical substations.
- design suitable control circuit for starting of three phase induction motor and synchronous motor.

Text Books:
1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers.

References Books:
1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers, sixth edition, 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		L	T	P	C
		3	0	0	3
POWER ELECTRONICS DEVICES & CIRCUITS **(Open Elective-I)**					

Preamble

The course is intended to make the difference between signal and power semiconductor devices in their physical operation and characteristics.

Learning Objectives:

- To understand the physics of basic semiconductor devices and power diode.
- To study the physics and operating characteristics of BJT and power MOSFET.
- To understand the operation and characteristics of thyristor and GTOs.
- To understand the physics and characteristics of IGBT.
- To study the operation of emerging devices and their integrated circuits.

UNIT -I:

Basic Semiconductor Physics & Power Diodes

Basic Semiconductor Physics: Introduction - Conduction Process in Semiconductors - pn junction - Avalanche Breakdown -

Power Diodes: Introduction - Basic Structures and I-V Characteristics - Breakdown Voltage Considerations - Switching Characteristics.

UNIT -II:

Bipolar Junction Transistors & Power MOSFET

Bipolar Junction Transistors: Introduction - Vertical Power Transistor Structures - Characteristics - Physics of BJT Operation - Switching Characteristics - Breakdown Voltages - Second Breakdown - On-State Losses - Safe Operating Areas.

Power MOSFET: Introduction – Basic Structure - I-V Characteristics - Physics of Device Operation - Switching Characteristics - Operating Limitations and Safe Operating Areas.

UNIT -III:

Thyristors & GTO

Thyristors: Introduction - Basic Structure – I-V Characteristics – Physics of Device Operation – Switching Characteristics - Methods of Improving di/dt and dv/dt Ratings

GTO: Introduction - Basic Structure – I-V Characteristics - Physics of Turn-off Operation – Switching Characteristics.

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UNIT -IV:
Insulated Gate Bipolar Transistors
Introduction – Basic structure – I-VCharacteristics – Physics of Devices Operation – Latchup in IGBTs – Switching Characteristics.

UNIT -V:
Emerging Devices and Circuits
Introduction – Power Junction Field Effect Transistors – Field-controlled Thyristor – JFET – Based Devices versus Other Power Devices – MOS-controlled Thyristor – Power Integrated Circuits.

Learning Outcomes:
After the completion of the course the student should be able to:
- explain the basics of semiconductor devices and use of Power diode.
- know the operation and characteristics of BJT and power MOSFETs.
- explain the basic difference of thyristors and GTOs in their physics and characteristics.
- know the operation of IGBT, emerging devices and circuits.

Text Books:
1. Power Electronics: converters, applications & design -by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
3. Power Electronics – by P.S.Bhimbra, Khanna Publishers.

Reference Books:
1. Elements of Power Electronics–Philip T.Krein. oxford.
2. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.
3. Thyristorised Power Controllers – by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier.
5. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

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COURSE STRUCTURE-R19

III Year – II SEMESTER		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
FUNDAMENTALS OF ELECTRICAL MACHINES **(OPEN ELECTIVE-I)**					

Preamble:

This course introduces the fundamentals of basic electrical circuits and topics related to principles, performance, applications and design considerations of dc machines and transformers. The course also covers the topics of different types of 3-phase induction motors and synchronous machines synchronous machines and their applications.

Learning Objectives:

- Understand the fundamentals in electrical machines.
- Know the characteristics of DC machines.
- Understand the operation and performance of Transformer.
- Understand the operation and starting methods of Induction motors.
- Understand the operation and application of Synchronous machine.

UNIT -I:

Introduction

Active and passive elements**-** Ohm's Law – Kirchhoff's Laws –Electromagnetic Induction– Faraday's Laws - Series – Parallel circuits- Self and Mutual Inductance-Numerical problems. Purpose of Earthing – Methods of Earthing – Merits of Earthing. Different types of Electrical Machines.

UNIT -II:

DC Machines

Principle of operation of DC generator - Types of DC machines – EMF equation –- Open Circuit Characteristics- Principle of operation of DC Motor- Torque Equation- speed control methods of DC motor – Losses in DC machines - Swinburne's Test-Brake test on DC shunt motor – Performance Characteristics - Numerical problems.

UNIT -III:

Transformers

 Principle of operation and construction Details – Classification of Transformers - EMF equation – Losses in a Transformer – Open Circuit & Short Circuit Test – Calculation of efficiency and regulation -Numerical Problems.

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UNIT -IV:
Induction Motors
Principle of operation- Constructional Details - Classification – Revolving Magnetic Fields– Starting Methods – Numerical Problems. Principle of operation of Single Phase Induction Motor - Starting Methods- Applications.

UNIT -V:
Synchronous Machines
Principle of operation and construction of alternators –EMF Equation - Regulation of alternator by Synchronous Impedance Method – Numerical Problems.
Principle of operation of synchronous motor - Synchronous Condenser – Applications.

Learning Outcomes:
After the completion of the course the student should be able to:
- Apply fundamentals in various electrical circuits.
- Explain the operation and characteristics of DC machines.
- Determine the efficiency and regulation of transmission.
- Explain the operation and starting methods of Induction Motors.
- Apply the applications of Synchronous Machines.

Text Books:
1. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
2. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
3. Circuit Theory (Analysis and Synthesis) by A. Chakrabarti, Dhanpat Rai & Co.

Reference Books:
1. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah,TMH Publications
2. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications,2nd edition
3. Basic Electrical Engineering by Nagsarkar,Sukhija, Oxford Publications,2nd edition

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		L	T	P	C
III Year –II SEMESTER		**0**	**0**	**3**	**1.5**
	POWER ELECTRONICS LABORATORY				

Learning objectives:
- To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
- To analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- To understand the operation of AC voltage regulator with resistive and inductive loads.
- To understand the working of Buck converter, Boost converter and inverters.

Any 10 of the Following Experiments are to be conducted
1. Characteristics of Thyristor, MOSFET & IGBT.
2. R, RC & UJT firing circuits for SCR.
3. Single -Phase semi converter with R & RL loads.
4. Single -Phase full converter with R & RL loads.
5. Three- Phase full converter with R &RL loads.
6. Single Phase dual converter in circulating current & non circulating current mode of operation.
7. Single -Phase AC Voltage Regulator with R & RL Loads.
8. Single Phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.

Learning outcomes:
After the completion of the course the student should be able to:
- study the characteristics of various power electronic devices.
- analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- understand the operation of single phase AC voltage regulator with resistive and inductive loads.
- understand the working of Buck converter, Boost converter, single–phase square wave inverter and PWM inverter.

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		L	T	P	C
III Year –II SEMESTER		0	0	3	1.5
	MICRO PROCESSORS AND MICRO CONTROLLERS LAB				

Learning Objectives:
- To study programming based on 8086 microprocessor and 8051 microcontroller.
- To study 8086 microprocessor based ALP using arithmetic, logical and shift operations.
- To study to interface 8086 with I/O and other devices.
- To study parallel and serial communication using 8051& PIC 18 micro controllers.

Any 10 of the following experiments are to be conducted:

I. Microprocessor 8086&Microcontroller 8051

Introduction to MASM/TASM.
1. Arithmetic operation – Multi byte addition and subtraction, multiplication and division – Signed and unsigned arithmetic operation, ASCII – Arithmetic operation.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
3. By using string operation and Instruction prefix**:** Move block, Reverse string Sorting, Inserting, Deleting, Length of the string, String comparison.
4. Interfacing 8255–PPI with 8086.
5. Interfacing 8259 – Interrupt Controller with 8086.
6. Interfacing 8279 – Keyboard Display with 8086.
7. Stepper motor control using 8253/8255.
8. Reading and Writing on a parallel port using 8051
9. Timer in different modes using 8051
10. Serial communication implementation using 8051
11. Understanding three memory areas of 00 – FF Using 8051 external interrupts.
12. Traffic Light Controller using 8051.

Learning Outcomes:
After the completion of the course the student should be able to:
- write assembly language program using 8086 micro based on arithmetic, logical, and shift operations.
- interface 8086 with I/O and other devices.
- do parallel and serial communication using 8051 & PIC 18 micro controllers.

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		L	T	P	C
III Year –II SEMESTER		**3**	**0**	**0**	**0**
EMPLOYABILITY SKILLS					

Preamble: This course is introduced to enhance the soft and hard skills of students based on industry needs and helping the student to get the employment in the competitive industrial environment.

Course Objective: In the this course the student should understand:
   (i) Aptitude skill (ii) Soft skills (iii) Skills required for campus placement interview

Unit 1: Aptitude Skills
Quantitative Aptitude:
Numbers, HCF and LCM, Problems on ages, Averages, Ratio and Proportion, Percentages, Profit and Loss, Partnership, Interest calculations, Time and Work, Time and Distance, Pipes and Cisterns, Mensuration
Reasoning:
Number and Letter Analogy, Coding and decoding, Odd Man out, Symbols and Notations, Permutations and Combinations, Probability, Data Interpretation, Data Sufficiency, Clocks and Calendars, Deductions, Logical Connectives, Venn Diagrams, Cubes, Binary Logic, Ordering and Sequencing, Blood relations – Syllogisms - Seating arrangement, Analytical Reasoning

Unit 2: Skills - I
Soft Skills: An Introduction – Definition and Significance of Soft Skills; Process, Importance and Measurement of Soft Skill Development. **Self-Discovery:** Discovering the Self; Setting Goals; Beliefs, Values, Attitude, Virtue. Goal Setting-Vision Vs Mission Vs Goals, SMART Technique to Goal Setting, SWOT Analysis. **Self Esteem:** Types of Self Esteem, Causes of Low Self Esteem, Merits of Positive Self Esteem and Steps to build a positive Self Esteem; Art of Compromise, Learn to Say:'I Don't Know', Being organized, Showing Self-awareness, Self-Assessment for Attainable Career Objectives. **Attitude & Confidence:** Attitude Vs Skills Vs Knowledge, Attitude Vs Behaviour, Developing Positive Attitude and Confidence; Fear-Public Speaking, Steps to Overcome Fear, developing Positive Thinking and Attitude; Driving out Negativity; Meaning and Theories of Motivation; Enhancing Motivation Levels, Adjusting Your Attitude-Arrogance has no Place in the Workplace, Cultural Sensitivity in the Workplace**,** Corporate Culture: Learning How to Fit in. **Motivational Talk:** Team Work, Team Vs Group, Stages in Team Building, Mistakes to avoid and Lessons to Learn.

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Unit 3: Skills – II:
Interpersonal Communication: Interpersonal relations; communication models, process and barriers; team communication; developing interpersonal relationships through effective communication; essential formal writing skills; corporate communication styles – assertion, persuasion, negotiation. **Listening:** Listening Vs Hearing, Possible reasons for why people do not Listen at times, Active Listening Vs Passive Listening, Listening effect on relationships. **Public Speaking:** Skills, Methods, Strategies and Essential tips for effective public speaking. **Group Discussion:** Importance, Planning, Elements, Skills assessed; Effectively disagreeing, Initiating, Summarizing and Attaining the Objective. **Non-Verbal Communication:** Importance and Elements; Body Language-Postures, gestures, eye contact. **Teamwork and Leadership Skills:** Concept of Teams; Building effective teams; Concept of Leadership and honing Leadership skills. **Presentation Skills:** Types, Content, Audience Analysis, Essential Tips – Before, During and After, Overcoming Nervousness. **Etiquette and Manners:** Social and Business. **Time Management** – Concept, Essentials, Tips.

Unit 4: Personality Development: Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills. **Decision-Making and Problem-Solving Skills:** Meaning, Types and Models, Group and Ethical Decision-Making, Problems and Dilemmas in application of these skills. **Conflict Management:** Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution. **Stress Management:** Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress. **Leadership and Assertiveness Skills:** A Good Leader; Leaders and Managers; Leadership Theories; Types of Leaders; Leadership Behaviour; Assertiveness Skills. **Emotional Intelligence:** Meaning, History, Features, Components, Intrapersonal and Management Excellence; Strategies to enhance Emotional Intelligence.

Unit 5: Group Discussions (GD):
Stages of a GD, GD Vs Debate, Skills assessed in a GD, Blunders to be avoided, Dos & Don'ts, GD-Practice: Conducting practice sessions and Brain Storming Sessions, Evaluation, feedback on their performance
Resume Preparation: Resume Templates, Steps followed for resume preparation, Common mistakes in a resume; Covering letter
Campus Placements Skills: Stages of Campus Placement, Skills assessed in Campus Placements, Changing scenario and its Challenges & How to get ready, Motivational Talk on Positive Thinking: Beliefs, Thoughts, Actions, Habits & Results (Success);
Interview Skills: Types of Interview, Interviewer and Interviewee – in-depth perspectives; Before, During and After the Interview; Tips for Success, Dress code and Grooming, Dos & Don'ts, Skills assessed in an Interview, Mistakes to be avoided, How to equip oneself to excel;

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How to handle the Typical Interview Questions; Mock Interviews: Unconventional HR questions, Practice sessions with Feedback, **Simulated Testing:** Previous model papers of companies,
Business Terminology: Financial Terms such as Debt, Equity, Share, Working Capital, Turnover, Net worth etc; Vision, Mission, Objectives, Goals, Targets

Course Outcomes: After studying this course the student should able to
(i) solve aptitude and reasoning problems (ii) apply the soft skills in dealing the issues related to employability (iii) successful in getting employment in campus placement interview

References:
1) B. K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2) S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.
3) R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand & Company Ltd., 2018.
4) Raman, Meenakshi & Sharma, Sangeeta, Technical Communication Principles and Practice, Oxford University Press, 2011.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
SWITCHGEAR AND PROTECTION					

Preamble:

In order to supply power from generating end to receiving end several equipments are connected in to the system. In order to protect the equipments and components against various operating conditions and over voltages protective devices are required to be installed in the system. Topics specified in this subject deal with various types of protective equipments and their working principle including limitations etc.

Learning objectives:

- To provide the basic principles and operation of various types of circuit breakers.
- To study the classification, operation and application of different types of electromagnetic protective relays.
- To explain protective schemes, for generator and transformers.
- To impart knowledge of various protective schemes used for feeders and bus bars.
- To explain the principle and operation of different types of static relays.
- To study different types of over voltages in a power system and principles of different protective schemes for insulation co–ordination.

UNIT–I:

Circuit Breakers

Miniature Circuit Breaker(MCB)– Elementary principles of arc interruption– Restriking Voltage and Recovery voltages– Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Introduction to oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– CB ratings and specifications– Concept of Auto reclosing.

UNIT–II:

Electromagnetic Protection

Relay connection – Balanced beam type attracted armature relay - induction disc and induction cup relays–Torque equation - Relays classification–Instantaneous– DMT and IDMT types– Applications of relays**:** Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays**:** Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

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UNIT–III:
Generator Protection
Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection
Protection of transformers**:** Percentage differential protection– Design of CT's ratio– Buchholz relay protection–Numerical examples.

UNIT–IV:
Feeder and Bus bar Protection
Protection of lines**:** Over current Protection schemes – PSM,TMS - Numerical examples -Carrier current and three zone distance relay using impedance relays–Protection of bus bars by using Differential protection.

UNIT–V:
Static and Digital Relays & Protection against over voltage and grounding
Static relays**:** Static relay components– Static over current relays– Static distance relay– Micro processor based over current relay, block diagram approach of Numerical Relays.

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters – Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding**:** Solid–resistance–Reactance–Arcing grounds and grounding Practices.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand the principles of arc interruption for application to high voltage circuit breakers of air, oil, vacuum, SF_6 gas type.
- understand the working principle and operation of different types of electromagnetic protective relays.
- students acquire knowledge of faults and protective schemes for high power generator and transformers.
- improves the ability to understand various types of protective schemes used for feeders and bus bar protection.
- understand different types of static relays and their applications.
- understand different types of over voltages and protective schemes required for insulation co–ordination.

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Text Books:
1. Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications
2. Power system protection- Static Relays with microprocessor applications.by T.S.MadhavaRao,TMH

Reference Books:
1. Fundamentals of Power System Protection by Paithankar and   S.R.Bhide.,PHI, 2003.
2. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
3. Protection and SwitchGear by BhaveshBhalja, R.P. Maheshwari, Nilesh G.Chothani, Oxford University Press, 2013.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
	OOPS THROUGH JAVA				

Preamble:
This course is designed to impart the programming skills to the students with OOPS concepts. This course covers OOPS principles, inheritance, classes AWT etc.

Learning Objectives:

- Understanding the OOPS concepts, classes and objects, threads, files, applets, swings and act.
- This course introduces computer programming using the JAVA programming language with object-oriented programming principles.
- Emphasis is placed on event-driven programming methods, including creating and manipulating objects, classes, and using Java for network level programming and middleware development

UNIT-I:
INTRODUCTION TO JAVA:

Introduction to OOP, procedural programming language and object oriented language, principles of OOP, applications of OOP, history of java, java features, JVM, program structure.

Variables, primitive data types, identifiers, literals, operators, expressions, precedence rules and associativity, primitive type conversion and casting, flow of control.

UNIT-II:
OBJECTS AND CLASSES:

Classes and objects, class declaration, creating objects, methods, constructors and constructor overloading, garbage collector, importance of static keyword and examples, this keyword, arrays, command line arguments, nested classes.

UNIT-III:
INHERITANCE:

Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class.

Interfaces, creating the packages, using packages, importance of CLASSPATH and java.lang package. Exception handling, importance of try, catch, throw, throws and finally block, user-defined exceptions, Assertions.

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UNIT-IV:
MULTITHREADING:
Introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files, random access file,

UNIT-V:
APPLETS AND AWT CLASSES:
Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners, adapter classes, inner classes.

AWT: introduction, components and containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Container class, Layouts, Menu and Scrollbar.

 Learning Outcomes:
After the completion of the course the student should be able to:
- understand Java programming concepts and utilize Java Graphical User Interface in Program writing.
- write, compile, execute and troubleshoot Java programming for networking concepts.
- build Java Application for distributed environment.
- design and Develop multi-tier applications.
- identify and Analyze Enterprise applications.

Text Books:
1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, Saurabh Choudary, Oxford.
3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.

Reference Books:
1. Swing: Introduction, JFrame, JApplet, JPanel, Componets in Swings, Layout Managers in
2. Swings, JList and JScrollPane, Split Pane, JTabbedPane, JTree, JTable, Dialog Box.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
RENEWABLE ENERGY SYSTEMS					

Preamble:
This course gives a flavor of renewable sources and systems to the students. It introduces solar energy its radiation, collection, storage and its applications. This covers generation, design, efficiency and characteristics of various renewable energy sources including solar, wind, hydro, biomass, fuel cells and geothermal systems.

Learning Objectives:
- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar photo voltaic systems.
- To study maximum power point techniques in solar pv and wind energy.
- To study wind energy conversion systems, Betz coefficient, tip speed ratio.
- To study basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

UNIT–I:
Fundamentals of Energy Systems and Solar energy
Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation**:** Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surfaces – Numerical problems.

UNIT–II:
Solar Photovoltaic Systems
Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Cell I-V characteristics – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Applications and systems – Balance of system components - System design**:** storage sizing – PV system sizing – Maximum power point techniques**:** Perturb and observe (P&O) technique – Hill climbing technique.

UNIT–III:
Wind Energy
Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator(synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

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UNIT–IV:
Hydro and Tidal power systems
Basic working principle – Classification of hydro systems**:** Large, small, micro – measurement of head and flow – Energy equation – Types of turbines – Numerical problems.
Tidal power – Basics – Kinetic energy equation – Turbines for tidal power - Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

UNIT–V:
Biomass, fuel cells and geothermal systems
Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.
Fuel cell**:** Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics.
Geothermal**:** Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

Learning Outcomes:
After the completion of the course the student should be able to:

- analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
- design solar thermal collectors, solar thermal plants.
- design solar photo voltaic systems.
- develop maximum power point techniques in solar PV and wind energy systems.
- explain wind energy conversion systems, wind generators, power generation.
- explain basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

Text Books:
1. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.
2. Non Conventional sources of Energy by G.D.Rai, Kanna Publications.

Reference Books:
1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
3. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
4. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
5. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
6. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
7. Non conventional energy source –B.H.khan- TMH-2nd edition.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
	UTILIZATION OF ELECTRICAL ENERGY **(ELECTIVE-II)**				

Preamble:

This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Energy Storage Systems concepts are also introduced as a part of this course.

Course Educational Objectives:

- To study the basic principles of illumination and its measurements and to design the different types lighting systems.
- To acquaint with the different types of heating and welding techniques.
- To understand the operating principles and characteristics of various motors with respect to speed, temperature and loading conditions.
- To understand the basic principles of electric traction including speed–time curves of different traction services and calculation of braking, acceleration and other related parameters.
- To Introduce the concept of various types of energy storage systems.

UNIT – I:

Illumination fundamentals

Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light

Various Illumination Methods

Discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting, Energy conservation.

UNIT – II:

Electric Heating

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding

Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

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UNIT – III:
Selection of Motors
Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.

UNIT – IV:
Electric Traction – I
System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves.

Electric Traction – II
Calculations of tractive effort– power –Specific energy consumption for given run–Effect of varying acceleration and braking retardation–Adhesive weight and braking retardation adhesive weight and coefficient of adhesion–Principles of energy efficient motors.

UNIT – V:
Introduction to energy storage systems
Need for energy storage, Types of energy storage-Thermal, electrical, magnetic and chemical storage systems, Comparison of energy storage technologies-Applications.

Course Outcomes:
After the completion of the course the student should be able to:
- understand various levels of illuminosity produced by different illuminating sources and able to estimate the illumination levels produced by various sources and recommend the most efficient illuminating sources and should be able to design different lighting systems by taking inputs and constraints in view.
- identify most appropriate heating and welding techniques for suitable applications.
- identify a suitable motor for electric drives and industrial applications
- determine the speed/time characteristics of different types of traction systems and determination of various traction parameters.
- know the necessity and usage of different energy storage schemes for different applications.

Text Books:
1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai&Sons.
3. "Thermal energy storage systems and applications"-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons 2002.

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Reference Books:
1. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
2. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International(P)Limited,Publishers,1997.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
	DATA BASE MANAGEMENT SYSTEMS **(ELECTIVE-II)**				

Preamble:

This course is an elective course designed to impart knowledge in data bases to the students which may be useful the SCADA, power system automation, etc. This course covers database principles, Normal forms, Database models, SQL queries, Data storage etc.

Learning Objectives:

- Fundamentals of DBMS.
- Different modes of DBMS.
- Basic query structures and normal forms.
- Control aspects of DBMS.
- File organization and indexing.

UNIT-I:

An Overview of Database Management

Introduction- What is Database System- What is Database-Why Database- Data Independence-Relation Systems and Others- Summary,

Database system architecture, Introduction- The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level- Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

UNIT-II:

The E/R Models, The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and Er Diagrams-Entities Attributes, and Entity Sets-Relationship and Relationship Sets-Conceptual Design With the Er Models, The Relational Model Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus, Tuple Relational Calculus- Domain Relational Calculus.

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UNIT-III:

Queries, Constraints, Triggers:

The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.

Schema Refinement (Normalization) : Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

UNIT-IV:

Transaction Management and Concurrency Control

Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point.

Concurrency control for lost updates, uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods : lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering : Wait/Die and Wound/Wait Schemes, Database Recovery management : Transaction recovery.

UNIT-V:

Overview of Storages and Indexing, Data on External Storage- File Organization and Indexing – Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree-Based Indexing, Comparison of File Organization

Learning Outcomes:

After the completion of the course the student should be able to:

- describe a relational database and object-oriented database.
- create, maintain and manipulate a relational database using SQL
- describe ER model and normalization for database design.
- examine issues in data storage and query processing and can formulate appropriate solutions.
- understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage.
- design and build database system for a given real world problem

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Text Books:

1. Introduction to Database Systems, CJ Date, Pearson

2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition

3. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom Pearson

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel7th Edition.

2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education

3. Introduction to Database Systems, C.J.Date Pearson Education.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
	ADVANCED CONTROL SYSTEMS **(ELECTIVE-II)**				

Preamble:
This subject aims to study state space, design of state feedback controllers and state observers, describing function and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

Learning Objectives:
- To familiarize the state space representation in controllable, observable, diagonal and Jordan canonical forms and introduce the concept of controllability and observability tests through canonical forms.
- Design of state feedback controller by pole placement technique and State Observer design.
- Analysis of a nonlinear system using describing function approach and the Lypanov's method of stability analysis of a system.
- Formulation of Euler Laugrange equation for the optimization of typical functionals and solutions.
- Formulation of linear quadratic optimal regulator (LQR) problem by parameter adjustment and solving riccatti equation.

UNIT – I:
State space analysis
State Space Representation in Canonical forms – Controllable canonical form – Observable canonical form – Diagonal Canonical Form - Jordan Canonical Form - Principle of duality – Controllability and observability test from Jordan canonical form and other canonical forms.

UNIT – II:
Design of state feedback controllers and state Observers
Design of state feedback control through pole placement and Ackerman's formula – Design of state observers (Full order & reduced order).

UNIT – III:
Describing function analysis
Introduction to nonlinear systems, Types of nonlinearities, describing functions, stability using describing functions.

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Stability analysis
Stability in the sense of Lyapunov – Lyapunov's stability and Lypanov's instability theorems – Direct method of Lyapunov for the linear and nonlinear continuous time autonomous systems.

UNIT–IV:
Calculus of variations
Minimization of functional of single function – Constrained minimization – Minimum principle – Control variable inequality constraints – Control and state variable inequality constraints – Euler lagrangine equation.

UNIT –V:
Optimal control
Linear Quadratic Optimal Regulator (LQR) problem formulation – Optimal regulator design by parameter adjustment (Lyapunov method) – Optimal regulator design by Continuous Time Algebraic Riccatti equation (CARE) - Optimal controller design using LQG framework.

Learning Outcomes:
After the completion of the course the student should be able to:
- formulate different state models in canonical forms.
- design of state feedback control using the pole placement technique and state observer design for a given control system.
- analyse of nonlinear system using the describing function technique and determine the stability of a linear autonomous system using lypnov method.
- determine minimization of functionals using calculus of variation studied.
- formulate and solve the LQR problem and riccatti equation.

Text Books:
1. Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998
2. Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

Reference Books:
1. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
3. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997.
4. Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.
5. Optimal control theory: an Introduction by Donald E.Kirk by Dover publications.

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		L	T	P	C
IV Year –I SEMESTER		**3**	**0**	**0**	**3**
	ELECTRICAL MACHINE DESIGN **(ELECTIVE-II)**				

Preamble:
This course is enables students to design transformers and rotating machines. Design is the prime job of the engineer. This course will provide insight into fundamentals of electrical machine design.

Learning Objectives:
- To understand the basics of design and cooling methods of rotating machines.
- To understand the design of DC machines.
- To understand the design concepts of transformers.
- To understand the design concepts of Induction motor.
- To understand the design concepts of Synchronous machines.

UNIT -I:
Fundamental Aspects of Electrical Machine Design
Design of machines - design factors - limitation in design - modern trends in electrical machine design – types of magnetic and insulating materials – modes of heat dissipation – cooling of rotating machines – methods of cooling.

UNIT -II:
Design of DC Machines
Construction details – design of different windings – output equation –selection of specific magnetic and electric loadings - separation of D and L – estimation of number of conductors, armature slots and conduct dimensions – choice of number of poles and calculation of length of airgap – design of field systems, interpoles and brushes.

UNIT -III:
Design of transformers
Transformer windings – output equation – determination of number of turns and length of mean term – design of core - choice of flux density – resistance and leakage reactance – no load current calculation – losses and efficiency – design of efficiency - cooling of transformers- calculation of number of tubes.

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UNIT -IV:
Design of Induction motors
Comparison between squirrel cage and wound rotors – choice of average flux density and ampere conduction for meter – output equation – design of stator slots and rotor slots – design of no load current – dispersion coefficient and its effects on performance of induction motor.

UNIT -V:
Design of Synchronous Machines
Types of construction – output equation - main dimensions – short circuit ration and its effects on the performance – design of rotor – temperature rise and its effects.

Learning Outcomes:
After the completion of the course the student should be able to:
- design main dimensions of rotating machines.
- design transformers and determine main dimensions.
- design field circuit of DC machines and Synchronous machines.
- design armature of DC machines and AC machines.

Text Books:
1. "Electrical Machines Design" , A.K.Sawhney, Dhanpath Rai & Co.

Reference Books:
1. "Performance and Design of DC Machines", Clayton & Hancock, ELBS.
2. "Performance and Design of AC Machines", M.G.Say; Pitman, ELBS.

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IV Year – I SEMESTER		L	T	P	C
		3	0	0	3
	HYBRID ELECTRIC VEHICLES **(Elective-II)**				

Preamble:
This course aims to study and understand merits of electric and hybrid electric vehicles. It also deals with different power electronic converters and battery storage systems for electric and hybrid electric vehicles.

Learning Objectives:
- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To known various architectures of hybrid electric vehicles.
- To understand the power management of plug in electric vehicles.
- To study and understand different power converters used in electrical vehicles.
- To familiarize with different batteries and other storage systems.

UNIT– I:
Introduction
Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles, advantages and applications of Electric and Hybrid Electric Vehicles, different Motors suitable for of Electric and Hybrid Electric Vehicles.

UNIT–II:
Hybridization of Automobile
Architectures of HEVs, series and parallel HEVs, complex HEVs.Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III:
Plug-in Hybrid Electric Vehicle
PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV:
Power Electronics in HEVs
Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

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UNIT– V:
Battery and Storage Systems
Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Learning Outcomes:
After the completion of the course the student should be able to:

- know the concept of electric vehicles and hybrid electric vehicles.
- familiar with different configuration of hybrid electric vehicles.
- understand the power converters used in hybrid electric vehicles
- know different batteries and other energy storage systems.

Text Books
1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.

ResearchBooks:

1. Pistooa G., "Power Sources , Models, Sustanability, Infrstructure and the market", Elsevier 2008
2. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives" 1995.

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IV Year –I SEMESTER			L	T	P	C
			3	0	0	3
	SWAYAM COURSE					

(ELECTIVE-II)

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	OPERATING SYSTEMS **(ELECTIVE-III)**				

Preamble:
This is an elective course introduced to understand the principles of operating systems used in SCADA, Power Systems Automation. This courses cover the operating system process scheduling, inter process communication, memory management, synchronization, file system and types of operating systems

Learning Objectives:

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.
- Study I/O management and File systems.
- Learn the basics of Linux system and perform administrative tasks on Linux Servers.

UNIT I:
Introduction to Operating System and Concept Process Management
Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types. Process concept, The process, Process State Diagram , Process control block, Process Scheduling- Scheduling Queues, Schedulers, Operations on Processes, Interprocess Communication, Threading Issues, Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-II:
Memory Management
Swapping, Contiguous Memory Allocation, Paging, structure of the Page Table, Segmentation
Virtual Memory Management
Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing

UNIT-III:
Concurrency
ProcessSynchronization, The Critical- Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples
Principles of deadlock
System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock

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UNIT-IV:
File system Interface
The concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.
File System implementation- File system structure, allocation methods, free-space management
Mass-storage structure overview of Mass-storage structure, Disk scheduling, Device drivers,

UNIT V:
Linux System
Components of LINUX, Interprocess Communication, Synchronisation, Interrupt, Exception and System Call.
Android Software Platform
Android Architecture, Operating System Services, Android Runtime Application Development, Application Structure, Application Process management

Learning Outcomes:
After the completion of the course the student should be able to:
- design various Scheduling algorithms.
- apply the principles of concurrency.
- design deadlock, prevention and avoidance algorithms.
- compare and contrast various memory management schemes.
- design and Implement a prototype file systems.
- perform administrative tasks on Linux Servers
- introduction to Android Operating System Internals

Text Books:
1. Operating System Concepts,Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
3. Operating Systems-S Halder, Alex A Aravind Pearson Education Second Edition 2016 .

References Books:
1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach,Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata Mc Graw-Hill Education, 2007.

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	NEURAL NETWORKS AND FUZZY LOGIC **(Elective-III)**				

Preamble:

This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Learning Objectives:

- To understand artificial neuron models & learning methods of ANN.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To understand different modules of fuzzy controller.
- To understand applications of neural networks and fuzzy logic.

Unit – I:

Introduction

Artificial Neural Networks (ANN) – Humans and computers – Biological neural networks – ANN Terminology – Models of Artificial neuron – activation functions – typical architectures – biases and thresholds – learning strategy(supervised, unsupervised and reinforced) – Neural networks learning rules. Single layer feed forward neural networks: concept of pattern and its types, perceptron training and classification using Discrete and Continuous perceptron algorithms– linear separability- XOR function.

Unit- II:

ANN Paradigms

Multi-layer feed forward networks –Generalized delta rule– Back Propagation algorithm – Radial Basis Function (RBF) network. Kohonen's self organizing feature maps (KSOFM), Learning Vector Quantization (LVQ)– Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

Unit–III:

Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

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UNIT IV:
Fuzzy Logic Modules
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT V:
Applications
Neural network applications: Load flow studies, load forecasting, reactive power control.
Fuzzy logic applications: Economic load dispatch, speed control of DC motors, single area and two area load frequency control.

Learning Outcomes:
After the completion of the course the student should be able to:

- know different models of artificial neuron & Use learning methods of ANN.
- use different paradigms of ANN.
- classify between classical and fuzzy sets.
- use different modules of Fuzzy logic controller.
- apply Neural Networks and fuzzy logic for real-time applications.

Text Books:
1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by RajasekharanandPai – PHI Publication.

Reference Books:
1. Artificial Neural Network – B.Yegnanarayana, PHI, 2012.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – Mc Graw Hill Inc, 1997.
3. Introduction to Neural Networks using MATLAB 6.0 – S N Sivanandam,SSumathi,S N Deepa TMGH
4. Introduction to Fuzzy Logic using MATLAB – S N Sivanandam,SSumathi,S N Deepa Springer, 2007.

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
HIGH VOLTAGE ENGINEERING **(ELECTIVE-III)**					

Preamble:
With the growth of power, HV power transmission has become an important subject. The performance of generating equipment requires knowledge of different phenomena occurring at higher voltage. Thus evaluations of various insulating materials are required for protection of HV equipments. Keeping this in view the course is designed to understand various phenomena related to breakdown study and withstand characteristics of insulating materials. The course also describes the generation and measurement of DC, AC and Impulse voltages as well various testing techniques.

Learning Objectives:
- To understand HV breakdown phenomena in gases, liquids and solids dielectrics.
- To acquaint with the generating principle of operation and design of HVDC, AC and Impulse voltages and currents.
- To understand various techniques for AC, DC and Impulse measurement of high voltages and currents.
- To understand the insulating characteristics of dielectric materials.
- To understand the various testing techniques of HV equipments.

UNIT–I:
Break down phenomenon in gaseous, liquid and solid insulation
Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases – Paschen's law – Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquid – Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of solid dielectrics, composite dielectrics used in practice.

UNIT–II:
Generation of High voltages and High currents
Generation of high DC voltages – Generation of high alternating voltages – Generation of impulse voltages and currents – Tripping and control of impulse generators.

UNIT–III:
Measurement of high voltages and High currents
Measurement of high AC, DC and Impulse voltages – Voltages and measurement of high currents – Direct, alternating and Impulse.

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UNIT–IV:
Non–destructive testing of material and electrical apparatus
Measurement of DC resistivity – Measurement of dielectric constant and loss factor – Partial discharge measurements.

UNIT–V:
High voltage testing of electrical apparatus
Testing of insulators and bushings – Testing of isolators and circuit breakers – Testing of cables – Testing of transformers – Testing of surge arresters – Radio interference measurements.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand theory of breakdown and withstand phenomenon for all types of dielectric materials.
- acquaint with the techniques of generation of AC,DC and Impulse voltages.
- apply knowledge for measurement of high AC,DC, Impulse voltages and currents.
- be in a position to measure dielectric property of materials used in HV equipment.
- know the testing techniques of various equipments used in HV engineering.

Text Books:
1. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier,2nd Edition.
2. High Voltage Engineering and Technology by Ryan, IET Publishers.

Reference Books:
1. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition
2. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
3. High Voltage Insulation Engineering by RavindraArora, Wolfgang Mosch, New Age International (P)Limited,1995.

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		L	T	P	C
IV Year –I SEMESTER		3	0	0	3
ENERGY AUDITING AND DEMAND SIDE MANAGEMENT **(ELECTIVE-III)**					

Preamble:

This course is developed to cater the current needs of the industry. This course covers topics in energy conservation. It also covers energy efficient lighting system. The student will learn power factor improvement techniques, energy efficiency in HVAC systems. In addition The economic aspects such as payback period calculations, life cycle costing analysis is covered in this course.

Learning Objectives:

- To understand energy efficiency, scope, conservation and technologies.
- To design energy efficient lighting systems.
- To estimate/calculate power factor of systems and propose suitable compensation techniques.
- To understand energy conservation in HVAC systems.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit–I:

Energy sources

Energy consumption – world energy reserves – prices – alternative sources – power – energy policies – choice of fuels.

Energy Auditing

Energy conservation schemes: Short term - Medium term - Long term energy conservation schemes – Industrial energy use - Energy index – Cost index .
Representation of energy consumption: Pie charts - Sankey diagrams – Load Profile.
Energy auditing: General Auditing, Detailed Energy Audit.

Unit–II:

Heat Transfer Theory

Heat – Heat content – Rate of heat transfer – Heat transfer coefficient - Conduction – Convention and radiation. Thermal insulation & its importance - space heating – HVAC system – Heating of Buildings – District heating – Factors & affecting the choice of district heating.

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Unit–III:
Energy Efficient Instruments

Digital Energy Meter – Data loggers – Thermo couples – Pyranometer – Lux meters – Tong testers – Power analyzers – Power factor – effects with non-linear loads – effect of harmonics on power factor – Power Factor Improvement – Capacitor rating - Effects of power factor improvements - Electric lighting – Types of lighting – Luminaries – Energy efficient lighting.

Unit–IV
Economic Aspects and Financial Analysis

Understanding energy cost: Depreciation methods – time value of money – rate of return – present worth method. Basic payback calculations –depreciation – net present value calculations. Taxes and tax credit – numerical problems.

Unit–V
Demand Side Management

Introduction to DSM - concept of DSM - benefits of DSM - different techniques of DSM – time of day pricing - multi-utility power exchange model - time of day models for planning. Load management - load priority technique - peak clipping - peak shifting - valley filling - strategic conservation - energy efficient equipment. Management and organization of energy conservation awareness programs.

Learning Outcomes:

After the completion of the course the student should be able to:

- explain energy efficiency, conservation and various technologies.
- design energy efficient lighting systems.
- calculate power factor of systems and propose suitable compensation techniques.
- explain energy conservation in HVAC systems.
- calculate life cycle costing analysis and return on investment on energy efficient technologies.

Text Books:

1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill

Reference Books:

1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.

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2. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
3. Energy management hand book by W.C.Turner, John wiley and sons.
4. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.
5. Industrial Energy Management Systems by Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.
6. Fundamentals of Energy Engineering by Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.
7. Economic Analysis of Demand Side Programs and Projects - California Standard Practise Manual, June 2002 – Free download available online
8. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.
9. Industrial Energy Management Systems by Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.
10. Fundamentals of Energy Engineering by Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.
11. Economic Analysis of Demand Side Programs and Projects - California Standard Practice Manual, June 2002 – Free download available online

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IV Year –I SEMESTER		L	T	P	C
		3	0	0	3
	DATA ANALYTICS WITH PYTHON				

Course Objectives:

The objective of the course is to

- Provide with the knowledge and expertise to become a proficient data scientist
- Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- Learn to statistically analyze a dataset
- Critically evaluate data visualizations based on their design and use for communicating stories from data

Course Outcomes:

At the end of the course, student will be able to

- Describe what Data Analysis is and the skill sets needed to be a data scientist
- Explain in basic terms what Statistical Inference means.
- Identify probability distributions commonly used as foundations for statistical modelling, Fit a model to data
- Use Python to carry out basic statistical modeling and analysis
- Apply basic tools (plots, graphs, summary statistics) to carry out Data Analysis

UNIT I

Statistical Thinking in the Age of Big Data. Exploratory Data Analysis, The Data Science Process

Machine Learning Algorithms, Linear Regression, k-Nearest Neighbors (k-NN), k-means, Logistic Regression

UNIT II

Python Language Basics, IPython, and Jupyter Notebooks: The Python Interpreter, IPython Basics, Python Language Basics, Built-in Data Structures, Functions, and Files, NumPy Basics: Arrays and Vectorized Computation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics

UNIT III

Data Loading, Storage, and File Formats: Reading and Writing Data in Text Format

Binary Data Formats, Interacting with Web APIs, Interacting with Databases

Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation

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UNIT IV
Data Wrangling: Join, Combine, and Reshape
Hierarchical Indexing, Combining and Merging Datasets, Reshaping and Pivoting
Plotting and Visualization: A Brief matplotlib API Primer, Plotting with pandas and seaborn
Other Python Visualization Tools

UNIT V
Data Aggregation and Group Operations: GroupBy Mechanics
Data Aggregation, Apply: General split-apply-combine, Pivot Tables and Cross-Tabulation
Time Series: Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Shifting, Time Zone Handling, Periods and Period Arithmetic, Resampling and Frequency Conversion, Moving Window Functions.

Text Books:
1) Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013.
2) McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

Reference Books:
1) Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
2) Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
3) Jiawei Han and Micheline Kamber (2006). "Data Mining: Concepts and Techniques."
4) "Algorithms for Data Science", 1st Edition, **Steele**, Brian, **Chandler**, John, **Reddy,** Swarna, springers Publications, 2016.

e-Resources:
1) https://nptel.ac.in/courses/106/107/106107220/

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		L	T	P	C
IV Year –I SEMESTER		**3**	**0**	**0**	**3**
	SWAYAM COURSE(ELECTIVE-III)				

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		L	T	P	C
IV Year –I SEMESTER		0	0	2	1

LINEAR & DIGITAL IC APPLICATIONS LAB

Learning Objective:
- To study the characteristics of Integrated circuits – IC 741, 555, 565.
- To develop the application circuits using IC's.
- To model the digital circuits for different applications.

List of experiments:
1. Determination of parameters like input & output offset voltages and currents, Slew rate, CMRR of op amp 741.
2. Inverting & Non Inverting Amplifiers.
3. Adders & Subtractors.
4. Integrator & Differentiator.
5. Active filter circuits: LPF & HPF (First Order)
6. IC 555 – Monostable & Astable Multivibrators Circuits
7. IC 556, 565-VCO & PLL applications.
8. Multiplexers & De-multiplexers.
9. MOD counter design using D & JK Flipflop.
10. Universal Shift Register.
11. 3-8 Decoder using 74138.
12. Schmitt Trigger circuit using IC 741.
13. ADC using IC 0809 & DAC using IC 741 circuits.

Learning Outcomes:

After the completion of the course the student should be able to:
- understand the characteristics of ICs-741, 555, 565, 566.
- apply the concepts of IC 741 for different applications.
- analyse the data connection circuits.
- develop the digital circuits.
- model the counters & Registers using IC's.

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IV Year – I SEMESTER		L	T	P	C
		0	0	2	1
POWER SYSTEMS & SIMULATION LAB					

Learning Objectives:

       To impart the practical knowledge of functioning of various power system components and determination of various parameters and simulation of load flows, transient stability, LFC and Economic dispatch.

Any 10 of the Following experiments are to be conducted:

1. Sequence impedances of 3 phase Transformer.
2. Sequence impedances of 3 phase Alternator by Fault Analysis.
3. Sequence impedances of 3 phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-seidel method
6. Load flow studies using N-R method..
7. Load frequency control of two area with &without control
8. Economic load dispatch with & without losses
9. Transient analysis of single machine connected to infinite bus(SMIB).
10. Modeling of transformer and simulation of lossy transmission line.
11. Analysis of three phase circuit representing the generator transmission line and load. Plot three phase currents & neutral current.
12. Simulation of transient response of RLC circuits
a) Response to pulse input
b) Response to step input
c) Response to sinusoidal input
13. Simulation of single–phase full converter using RLE loads and single phase AC voltage controller using RL loads
14. Plotting of Bode plots, root locus and nyquist plots for the transfer functions of systems up to 5th order

Learning Outcomes:

After the completion of the course the student should be able to:

- determine the parameters of various power system components which are frequently occur in power system studies and he can execute energy management systems functions at load dispatch center.

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		L	T	P	C
IV Year –I SEMESTER		**0**	**0**	**2**	**1**
INDUSTRIAL TRAINING /SKILL DEVELOPMENT PROGRAMS/ RESEARCH PROJECT					

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE STRUCTURE-R19

IV Year –I SEMESTER		L	T	P	C
		0	0	4	2
	PROJECT-I				

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		L	T	P	C
IV Year –II SEMESTER		3	0	0	3
	POWER SYSTEM OPERATION AND CONTROL				

Preamble:
This subject deals with Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

Learning Objectives:
- To understand optimal dispatch of generation with and without losses.
- To study the optimal scheduling of hydro thermal systems.
- To study the optimal unit commitment problem.
- To study the load frequency control for single area system with and without controllers
- .To study the load frequency control for two area system with and without controllers
- To understand the reactive power control and compensation of transmission lines.

UNIT–I:
Economic Operation of Power Systems
Optimal operation of Generators in Thermal power stations, – Heat rate curve – Cost Curve – Incremental fuel and Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

UNIT–II:
Hydrothermal Scheduling & Unit Commitment
Optimal scheduling of Hydrothermal System**:** Mathematical Formulation – Solution Technique. Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT–III:
Load Frequency Control-I
Modeling of steam turbine – Generator – Mathematical modeling of speed governing system – Transfer function – Necessity of keeping frequency constant – Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case. Proportional plus Integral control of single area and its block diagram representation – Steady state response.

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UNIT–IV:
Load Frequency Control-II
Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

UNIT–V:
Compensation in Power Systems
Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – compensated transmission lines – Introduction of FACTS devices – Types of FACTS devices - Need of FACTS controllers.

Learning Outcomes:
After the completion of the course the student should be able to:
- compute optimal scheduling of Generators.
- understand hydrothermal scheduling.
- understand the unit commitment problem.
- understand importance of the frequency.
- understand importance of PID controllers in single area and two area systems.
- understand reactive power control and compensation for transmission line.

Text Books:
1. Power Generation, Operation and Control by Allen J Wood, Bruce F WollenBerg 3rd Edition, Wiley Publication 2014.
2. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–hill Publishing Company Ltd., Second edition.
2. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.

Reference Books:
1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., Thompson, 3rdEdition.
3. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
4. Power System Analysis by HadiSaadat – TMH Edition.
5. Power System stability & control, PrabhaKundur,TMH

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	MEASUREMENTS AND INSTRUMENTATION **(OPEN ELECTIVE-II)**				

Preamble:
This course introduces the principle of operation of basic analog and digital measuring instruments for measurement of current, voltage, power, energy etc. Measurement of resistance, inductance and capacitance by using bridge circuits will be discussed in detail. It is expected that student will be thorough with various measuring techniques that are required for an electrical engineer.

Learning Objectives:
- To study the principle of operation and working of different types of instruments for measurement of Electrical Quantities.
- To study the working principle of operation of different types of instruments for measurement of power and power factor.
- To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
- To understand the principle of operation and working of transducers.
- To study the principle of operation and working of DVMS, Power analyser and applications of CRO.

UNIT–I:
Analog Ammeter and Voltmeters
Classification – deflecting, control and damping torques,– PMMC, Moving Iron type and Electrostatic instruments, Construction, Torque equation, advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer-construction, theory, (Without derivation of ratio and phase angle error) - Numerical Problems.

UNIT –II:
Analog Wattmeters and Power Factor Meters
Electrodynamometer type wattmeter (LPF and UPF), Power factor meters: Dynamometer and M.I type (Single phase), construction, theory, torque equation, advantages and disadvantages - Numerical Problems.

UNIT – III:
Measurements of Electrical parameters
DC Bridges: Method of measuring low, medium and high resistance – Kelvin's double bridge for measurement low resistance, Wheatstone bridge for measurement of medium resistance - Loss of charge method for measurement of high resistance, Megger – measurement of earth resistance - Numerical Problems.

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AC Bridges: Measurement of inductance and quality factor, Maxwell's bridge, measurement of capacitance and loss angle, Desauty's bridge, Schering Bridge, Wien's bridge- Numerical Problems.

UNIT – IV:
Transducers
Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Digital shaft encoders, Hall effect sensors- Numerical Problems.
.
UNIT – V:
Digital meters

Digital voltmeter – Successive approximation DVM, – Digital frequency meter, Digital multimeter, Digital tachometer, Digital Energy Meter, LCRQ - Meter,

Learning Outcomes:
After the completion of the course the student should be able to:
- choose right type of instrument for measurement of ac and dc Electrical quantities.
- choose right type of instrument for measurement of power and power factor.
- select right type for measurement of R, L,C.
- understand the effectiveness of Transducer.
- understand Digital Meters.

Text Books:
1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:
1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai &Co.Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
3. Electrical Measurements by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
FUNDAMENTALS OF UTILIZATION OF ELECTRICAL ENERGY **(OPEN ELECTIVE -II)**					

Preamble:

In the modern society, every engineer is using electrical energy irrespective of their branch of specialization. To provide knowledge about the various electrical energy utilization technologies to non-electrical engineering students this course is developed. In this course, a detailed description about the various sources of electrical energy, illumination requirements and energy conservation, various techniques used for heating & welding applications, and brief description about the electric traction are presented. At the end of the course, an insight in to the importance, techniques, and testing of electrical equipment earthing is also presented.

Learning Objectives:

- To know various sources of electrical energy, methods used for generation of electrical energy.
- To study the various types of Illumination equipment, measurement of Illumination, Illumination techniques.
- To know the various technologies used for heating and welding applications using electrical energy.
- To know the various systems of traction, equipment used for traction.
- To understand the importance of earthing, earthing equipment and earthing measurement of electrical equipment.

Unit-I:

Sources of Electrical Energy

Conventional Sources: Schematic & description of components of thermal power plant - hydro electric power station and nuclear power plants.

Non-conventional sources: schematic and description of components - Solar power generation - Wind power generation – Tidal - Geo-Thermal - Bio energy - Fuel cells technology.

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Unit-II:
Illumination

Introduction, source of light, term used in illumination - Lux meter - Discharge lamp - MV and SV lamps - types and design of light as flood light - LED light - shed lighting and domestic light - conservation of energy.

Unit-III:
Heating and Welding

Advantages of Electric heating - types of electric heating - Resistance Heating - properties of heating element - direct heating - indirect heating - Induction heating - Factors effecting heat – Characteristics – application - description of direct core - vertical core - indirect core and core less type of Induction heating - Dielectric heating – applications of dielectric heating. Advantages of heating – arc furnace – direct arc furnace – indirect arc furnace.

Welding: Introduction - Resistance welding – Spot welding – Projection welding –Seam welding – Butt welding – Arc welding – Metal arc welding – Helium arc welding – carbon arc welding – Hydrogen arc welding.

Unit IV:
Traction

Introduction – Advantages and disadvantages - systems of traction – classification – speed-time curve for different service – various factors affecting the energy consumption – components of electric locomotive (for collecting and discharging) – description of each component.

Unit -V:
Grounding

Introduction – earth and safety – nature of an electrode system – earth conductor sizes – design of earthing electrodes – earthing system – substation earthing mats – earthing practices – earth testing: methodology - earth tester and use

Learning Outcomes:

After the completion of the course the student should be able to:

- know the various sources of electrical energy and its generation technologies for conventional and non-conventional energy sources.
- know various types of illumination equipment, illumination measurement and illumination techniques.

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- learn about various methods used for electrical energy based heating and welding applications.
- know about the mechanisms, equipment and technology used in the electric traction.
- understand the importance of electrical earthing, earthing equipment and electrical earthing measurement methods.

Text Books:

1. Electrical Power Systems(Generation, Transmission, Distribution, Protecection and Utilization of Electrical Energy) – Dr. S.L.Uppal and Prof. Sunil S.Rao – Khanna Publisher, 15th edition, 1987.
2. Electric Power Distribution – A S Pabla – McGrawHill.

Reference Books:

1. Generation Distribution and Utilization of Electrical Energy – C.L.Wadhwa- New Age International Publishers- revised third edition.

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	CONCEPTS OF POWER SYSTEM ENGINEERING **(OPEN ELECTIVE-II)**				

Preamble:
This course introduces the basic concepts and overall view and basic knowledge regarding the power system engineering. The Course is giving the concepts of power generation, power transmission and distribution. It also covers protection, economics and power factor improvement concepts. This subject is very much useful to gain knowledge in the power sytems.

Learning Objectives:
- To understand the types of power plants.
- To understand the concepts of transmission and distribution
- To gain the knowledge of protection and grounding
- To know the economic aspects of electrical energy.
- To learn the importance of power factor improvement and voltage control.

UNIT–I:
Power Generation Concepts & Types
Generation and sources of Energy – Generating stations: Schematic arrangements of Steam Power Plant – Hydro Power Plant - Nuclear Power Plant – Gas Power Plants working principle and Schematic diagram approach only– Comparison between Power Plants.

UNIT–II:
Transmission and Distribution Concepts
Types of Conductors Materials - Constants of Transmission Line – Classification of Overhead Transmission Lines – Performance of Single Phase Short Transmission Lines – Simple Problems – Basic concept of Sub Station.
Distribution Systems – Connection Schemes of Distribution Systems – Structure of Cables – Differences between Overhead & Underground systems.

UNIT – III:
Protection and Grounding
List of Faults – Basic concepts of fuse - Circuit Breakers – Relays – SF_6 Circuit Breakers – Vacuum Circuit Breakers – Operation of Lightning Arrester – Grounding and its advantages - Methods of Neutral Grounding: Resistance, Reactance and Resonant Grounding – Numerical Problems.

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UNIT–IV:
Economic Aspects
Definitions of Load - Load & Load Duration Curves - Load Factor - Demand Factor – Utilization Factor - Loss Factor – Types of Tariff - Cost of Electrical Energy – Expression for Cost of Electrical Energy – Numerical Problems.

UNIT–V:
Power Factor Improvement and Voltage Control
Power Factor – Effects and Causes of low Power Factor – Power Triangle – Shunt & Series Capacitor Compensation - Numerical Problems – Need of Voltage Control – Types of Voltage regulating Devices.

Learning Outcomes:
After the completion of the course the student should be able to:
- gain knowledge on types of power plants.
- learn about transmission and distribution concepts.
- understsnd protection and grounding methods.
- learn the economic aspects of electrical energy.
- understand the power factor improvement and voltage control.

Text Books:
1. Principles of Power System by V.K.Mehata, Rohit Mehata, S.Chand Publishers.

Reference Books:
1. Electrical Power Systems by C.L.Wadwa, New Age International Publishers.

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	BASICS OF CONTROL SYSTEMS **(OPEN ELECTIVE-II)**				

Preamble :
This course introduces the basic principles of control systems for analyzing LTI systems and investigate their stability.

Learning Objectives:
- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers
- To investigate the stability of closed loop systems using Routh-Hurwitz criterion and analysis by root locus method.
- To present the Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots.
- Ability to formulate state models and analyze the systems. To learn the concepts of Controllability and Observability.

UNIT – I:
Mathematical modeling of control systems
Classification of control systems, open loop and closed loop control systems and their differences, transfer function of linear system, differential equations of electrical networks, translational and rotational mechanical systems, transfer function of DC servo motor – AC servo motor – block diagram algebra – representation by signal flow graph – reduction using Mason's gain formula, Feedback characteristics.

UNIT-II:
Time response analysis
Standard test signals – time response of first and second order systems – time domain specifications, steady state errors and error constants, P, PI,PID Controllers.

UNIT–III:
Stability and rootlocus technique
The concept of stability – Routh-Hurwitz –limitations of Routh-Hurwitz criterion,
Root locus concept – construction of root loci (simple problems).

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UNIT–IV:
Frequency response analysis
Introduction to frequency domain specifications – Polar Plot - Bode diagrams – transfer function from the Bode diagram – phase margin and gain margin – stability analysis from Bode plots.

UNIT–IV:
State space analysis of LTI systems
Concepts of state, state variables and state model, state space representation of transfer function, diagonalization, solving the time invariant state equations, State Transition Matrix and it's Properties, concepts of controllability and observability.

Learning Outcome:
After the completion of the course the student should be able to:
- derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- determine time response specifications of second order systems and to determine error constants.
- analyze absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
- analyze the stability of LTI systems using frequency response methods.
- represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:
1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India,2nd Edition.

Reference Books:

5. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
6. Control Systems by Manik Dhanesh N, Cengage publications.
3. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
4. Control Systems Engineering by S.Palani,Tata Mc Graw Hill Publications.

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IV Year – II SEMESTER		L	T	P	C
		3	0	0	3
	ENERGY AUDIT **(OPEN ELECTIVE-II)**				

Preamble:

This is an open elective course developed to cater the current needs of the industry. This course covers topics in energy conservation. It also covers energy efficient lighting system. The student will learn power factor improvement techniques, energy efficiency in HVAC systems. In addition the economic aspects such as payback period calculations, life cycle costing analysis is covered in this course.

Learning Objectives:

- To understand energy efficiency, scope, conservation and technologies.
- To design energy efficient lighting systems.
- To estimate/calculate power factor of systems and propose suitable compensation techniques.
- To understand energy conservation in HVAC systems.
- To calculate life cycle costing analysis and return on investment on energy efficient technologies.

Unit–I:
Energy sources
Energy consumption – world energy reserves – prices – alternative sources – power – energy policies – choice of fuels.

Energy Auditing
Energy conservation schemes: Short term - Medium term - Long term energy conservation schemes – Industrial energy use - Energy index – Cost index .
Representation of energy consumption: Pie charts - Sankey diagrams – Load Profile.
Energy auditing: General Auditing, Detailed Energy Audit.

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Unit–II:
Heat Transfer Theory
Heat – Heat content – Rate of heat transfer – Heat transfer coefficient - Conduction – Convention and radiation. Thermal insulation & its importance - space heating – HVAC system – Heating of Buildings – District heating – Factors & affecting the choice of district heating.

Unit–III:
Energy Efficient Instruments
Digital Energy Meter – Data loggers – Thermo couples – Pyranometer – Lux meters – Tong testers – Power analyzers – Power factor – effects with non-linear loads – effect of harmonics on power factor – Power Factor Improvement – Capacitor rating - Effects of power factor improvements - Electric lighting – Types of lighting – Luminaries – Energy efficient lighting.

Unit–IV
Economic Aspects
Costing Techniques – cost factors – break-even charts – sources of capital and hire charges - capital recovery – depreciation – budgeting and standard costing – charging energy – cash flow diagrams and activity charts.

Unit–V
Financial Analysis
Financial appraisal and profitability : investment decision- methods of investment appraisal-discounted cash flow – summary of investment appraisal techniques – Cost optimization – optimization with one variable – optimization with more than one variable.

Learning Outcomes:
After the completion of the course the student should be able to:
- explain energy efficiency, conservation and various technologies.
- design energy efficient lighting systems.
- calculate power factor of systems and propose suitable compensation techniques.
- explain energy conservation in HVAC systems.
- calculate life cycle costing analysis and return on investment on energy efficient technologies.

Text Books:
1. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
2. Hand Book of Energy Audit by Sonal Desai- Tata McGraw hill

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Reference Books:
1. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
2. Energy management by Paul o' Callaghan, Mc–Graw Hill Book company–1st edition, 1998.
3. Energy management hand book by W.C.Turner, John wiley and sons.
4. Energy management and conservation –k v Sharma and pvenkataseshaiah-I K International Publishing House pvt.ltd,2011.
5. Industrial Energy Management Systems by Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.
6. Fundamentals of Energy Engineering by Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.
7. Economic Analysis of Demand Side Programs and Projects - California Standard Practise Manual, June 2002 – Free download available online

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IV Year –II SEMESTER		L	T	P	C
		3	0	0	3
	ELECTRICAL DISTRIBUTION SYSTEMS **(ELECTIVE-IV)**				

Preamble:
This subject deals with the general concept of distribution system, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement.

Learning Objectives
- To study different factors of Distribution system.
- To study and design the substations and distribution systems.
- To study the concepts of voltage drop and power loss.
- To study the distribution system protection and its coordination.
- To study the effect of compensation for power factor improvement.
- To study the effect of voltage control on distribution system.

UNIT – I:
General Concepts
Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor loss factor – Numerical Problems – Load Modeling and Characteristics – Relationship between the load factor and loss factor – Classification and charcteristics of loads (Residential, commercial, Agricultural and Industrial).

UNIT – II:
Substations
Location of substations**:** Rating of distribution substation – Service area with'n'primary feeders – Benefits and methods of optimal location of substations..
Distribution Feeders
Design Considerations of distribution feeders**:** Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III:
System Analysis
Voltage drop and power–loss calculations**:** Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads – Numerical problems - Three phase balanced primary lines.

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UNIT – IV:

Protection, Coordination & Automation

Objectives of distribution system protection –Time current characteristics – Protective devices: Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers, Modulated case circuit breakers, Earth leakage circuit breakers – Protection schemes of parallel & Ringmain feeders.

Coordination of protective devices: General coordination procedure –Various types of co-ordinated operation of protective devices - Residual Current Circuit Breaker

Automation: Block diagram approach of SCADA.

UNIT – V:

Compensation for Power Factor Improvement

Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

Voltage Control

Voltage Control: Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Learning Outcomes:

After the completion of the course the student should be able to:

- understand various factors of distribution system.
- design the substation and feeders.
- determine the voltage drop and power loss
- understand the protection and its coordination.
- understand the effect of compensation forp.f improvement.
- understand the effect of voltage control.

Text Book:

1. "Electric Power Distribution system, Engineering" – by TuranGonen, McGraw–hill Book Company.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

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IV Year –II SEMESTER		L	T	P	C
		3	0	0	3
	HVAC & DC TRANSMISSION **(ELECTIVE–IV)**				

Preamble:
With the increasing power generation in the country and long distance power transmission, it is necessary that power should be transmitted at extra and ultra high voltage. The topics dealt in this subject relate to phenomena associated with transmission line at higher voltages, equipments generating high voltage and power control strategy.

Learning Objectives
- To understand the phenomena associated with transmission line, operating at extra high voltages. The unit gives detail analysis of several phenomena viz. electrostatic field, charges, voltage gradient and conductor configuration.
- The objective is to discuss phenomena of corona, losses, audible noise, radio interference and measurement of these quantities.
- To understand the phenomena of HVDC, HVDC equipment comparison with AC and the latest state of art in HVDC transmission.
- To understand method of conversion of AC to DC, performance of various level of pulse conversionand control characteristics of conversion.It also provides knowledge of effect of source inductance as well as method of power control.
- To understand the requirements of reactive power control and filtering technique in HVDC system.
- To understand the harmonics in AC side of power line in a HVDC system and design of filters for various levels of pulse conversion.

Unit – I:
Introduction of EHV AC transmission
Necessity of EHV AC transmission – Advantages and problems– Power handling capacity and line losses– Mechanical considerations – Resistance of conductors –Electrostatics – Field of sphere gap – Field of line charges and properties – Charge ~ potential relations for multi–conductors – Surface voltage gradient on conductors – Bundle spacing and bundle radius– Examples – Distribution of voltage gradient on sub conductors of bundle – Examples.

Unit – II:
Corona effects
Power loss and audible noise (AN) – Corona loss formulae – Charge voltage diagram – Generation – Characteristics – Limits and measurements of AN – Relation between 1–phase and 3–phase AN levels – Examples – Radio interference (RI) – Corona pulses generation –

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Properties and limits – Frequency spectrum – Modes of propagation – Excitation function – Measurement of RI, RIV and excitation functions – Examples.

UNIT – III:
Basic Concepts of DC Transmission
Economics & Terminal equipment of HVDC transmission systems**:** Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC transmission – Application of DC Transmission System – Planning & Modern trends in DC transmission.

UNIT – IV:
Analysis of HVDC Converters and System Control
Choice of Converter configuration – Analysis of Graetz – Characteristics of 6 Pulse & 12 Pulse converters –Cases of two 3 phase converters in star –Star mode and their performance – Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system – Starting and stopping of DC link – Power Control.

UNIT–V:
Reactive Power Control in HVDC and Filters
Reactive Power Requirements in steady state–Conventional control strategies–Alternate control strategies sources of reactive power–AC Filters – Shunt capacitors– Synchronous condensers.

Generation of Harmonics – Characteristics harmonics – Calculation of AC Harmonics – Non–Characteristics harmonics – Adverse effects of harmonics – Calculation of voltage & current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single tuned filters –Design of High pass filters.

Learning Outcomes:
After the completion of the course the student should be able to:
- acquaint with HV transmission system with regard to power handling capacity, losses, conductor resistance and electrostatic field associate with HV. Further knowledge is gained in area of bundle conductor system to improve electrical and mechanical performance.
- develop ability for determining corona, radio interference, audible noise generation and frequency spectrum for single and three phase transmission lines.
- acquire knowledge in transmission of HVDC power with regard to terminal equipments, type of HVDC connectivity and planning of HVDC system.
- develop knowledge with regard to choice of pulse conversion, control characteristic, firing angle control and effect of source impedance.
- develop knowledge of reactive power requirements of conventional control, filters and reactive power compensation in AC. side of HVDC system.

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- calculate voltage and current harmonics, and design of filters for six and twelve pulse conversion.

Text Books:

1. HVDC Power Transmission Systems: Technology and system Interactions – by K.R.Padiyar, New Age International (P) Limited, and Publishers.
2. Direct Current Transmission – by E.W.Kimbark, John Wiley & Sons.
3. EHVAC Transmission Engineering by R. D. Begamudre, New Age International (p) Ltd.

Reference Books:
1. EHVAC and HVDC Transmission Engineering and Practice – S.Rao.
2. Power Transmission by Direct Current – by E.Uhlmann, B.S.Publications
3. HVDC Transmission – J.Arrillaga.

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		L	T	P	C
IV Year –II SEMESTER		**3**	**0**	**0**	**3**

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS
(ELECTIVE-IV)

Preamble:
Flexible Alternating Current Transmission System controllers have become a part of modern power system. It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. As the heart of many power electronic controllers is a voltage source converter (VSC), the student should be acquainted with the operation and control of VSC. Two modern power electronic controllers are also introduced.

Learning Objectives:
- To learn the basics of power flow control in transmission lines using FACTS controllers
- To explain operation and control of voltage source converter.
- To understand compensation methods to improve stability and reduce power oscillations of a power system.
- To learn the method of shunt compensation using static VAR compensators.
- To learn the methods of compensation using series compensators
- To explain operation of Unified Power Flow Controller (UPFC).

Unit–I:
Introduction to FACTS
Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements and characteristics of high power devices – Voltage and current rating – Losses and speed of switching – Parameter trade–off devices.

Unit–II:
Voltage source and Current source converters
Concept of voltage source converter (VSC) – Single phase full wave bridge converter – Square wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter – Transformer connections for 12, 24 and 48 pulse operation, concept of Current Source Converter (CSC), Three–phase current source converter – Comparison of current source converter with voltage source converter.

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Unit–III:
Shunt Compensators
Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping – variable Impedance type VAR generator - Thyristor Switched/Controlled Reactor (TSR/TCR) – Thyristor Switched Capacitor(TSC) – Fixed Capacitor–Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor and Thyristor Controlled Reactor (TSC–TCR), Switching Converter type VAR generator – principle of operation - Comparison of SVC and STATCOM.

Unit IV:
Series Compensators
Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) - Switching Converter type Series Compensation.

Unit–V:
Combined Controllers
Voltage and Phase Angle Regulator - TCVR and TCPAR – Switched Converter Based Voltage-Phase Angle Regulator - Schematic and basic operating principles of Unified Power Flow Controller (UPFC), Interline Power Flow Controller (IPFC) - Application on transmission lines.

Learning Outcomes:
After the completion of the course the student should be able to:
- understand power flow control in transmission lines using FACTS controllers.
- explain operation and control of voltage source converter.
- analyze compensation methods to improve stability and reduce power oscillations in the transmission lines.
- explain the method of shunt compensation using static VAR compensators.
- understand the methods of compensations using series compensators.
- explain operation of Unified Power Flow Controller (UPFC).

Text Books:
1. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is available:—Standard Publications, 2001.

Reference Books:
1. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.MohanMathur and Rajiv k.Varma, Wiley.

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IV Year –II SEMESTER	L	T	P	C
	3	0	0	3

POWER QUALITY
(ELECTIVE-IV)

Preamble:
Power quality is a major problem for utilities and customers. Customers using sensitive critical loads need quality power for proper operation of the electrical equipment. It is important for the student to learn the power quality issues and improvement measures provided by the utility companies. This course covers the topics on voltage and current imperfections, harmonics, voltage regulation, power factor improvement, distributed generation, power quality monitoring and measurement equipment.

Learning Objectives:
- To learn different types of power quality phenomena.
- To identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- To describe power quality terms and study power quality standards.
- To learn the principle of voltage regulation and power factor improvement methods.
- To explain the relationship between distributed generation and power quality.
- To understand the power quality monitoring concepts and the usage of measuring instruments.

Unit–I:
Introduction
Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long–duration voltage variations – Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

Unit–II:
Voltage imperfections in power systems
Power quality terms – Voltage sags – Voltage swells and interruptions – Sources of voltage sag, swell and interruptions – Nonlinear loads – IEEE and IEC standards. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

Unit–III:
Voltage Regulation and power factor improvement:
Principles of regulating the voltage – Device for voltage regulation – Utility voltage

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regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

Unit– IV:
Harmonic distortion and solutions
Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors and meters – Point of common coupling – Passive and active filtering – Numerical problems.

Unit–V:
Distributed Generation and Power Quality Monitoring
Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts.
Power quality monitoring and considerations – Historical perspective of Power quality measuring instruments – Power quality measurement equipment – Assessment of Power quality measuring data.

Learning Outcomes:
After the completion of the course the student should be able to:
- differentiate between different types of power quality problems.
- explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
- analyze power quality terms and power quality standards.
- explain the principle of voltage regulation and power factor improvement methods.
- demonstrate the relationship between distributed generation and power quality.
- explain the power quality monitoring concepts and the usage of measuring instruments.

Textbooks:
1. Electrical Power Systems Quality, Dugan R C, Mc Granaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley India publications,2011.

Reference Books:
1. Power Quality Primer, Kennedy B W, First Edition, Mc Graw–Hill, 2000.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
3. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons, 2003.

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4. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
5. Power Quality c.shankaran, CRC Press, 2001
6. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor & Francis)
7. Power Quality in Power systems and Electrical Machines–EwaldF.fuchs, Mohammad A.S. Masoum–Elsevier.

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		L	T	P	C
IV Year –II SEMESTER		**3**	**0**	**0**	**3**
	SMART GRID (ELECTIVE-IV)				

Preamble:
Basic knowledge on smart concept communication protocols, renewable energy systems and electronic circuits.

Learning Objectives:
- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.
- To have knowledge on micro grids and distributed energy systems.
- To know power quality aspects in smart grid.

Unit-I:
Introduction to Smart Grid
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

Unit-II:
Smart Grid Technologies: Part 1
Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.

Unit-III:
Smart Grid Technologies: Part 2
Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).

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Unit-IV:
Micro grids and Distributed Energy Resources
Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuelcells, microturbines, Captive power plants, Integration of renewable energy sources.

Unit-V:
Power Quality Management in Smart Grid
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid
Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Course Outcomes:
After the completion of the course the student should be able to:
- understand smart grids and analyse the smart grid policies and developments in smart grids.
- develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- understand smart substations, feeder automation, GIS etc.
- analyse micro grids and distributed generation systems.
- analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Text Books:
1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response",CRC Press
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", Wiley
4. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010

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6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.

Reference Books:
1. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011
2. James Northcote, Green, Robert G. Wilson "Control and Automation of Electric Power Distribution Systems (Power Engineering)", CRC Press
3. MladenKezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert "Substation Automation (Power Electronics and Power Systems)", Springer
4. R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, "Electrical Power System Quality", 2nd Edition, McGraw Hill Publication
5. Yang Xiao, "Communication and Networking in Smart Grids", CRC Press

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		L	T	P	C
IV Year –II SEMESTER		**3**	**0**	**0**	**3**
	SPECIAL ELECTRICAL MACHINES **(ELECTIVE - IV)**				

Preamble:
This is an advanced course on electrical machines. Students will be exposed to various special machines which are gaining importance in industry. This course covers topics related to principles, performance and applications of these special machines including switched reluctance motors, stepper motors, permanent magnet dc motors and linear motors.

Learning Objective:
- To explain theory of operation and control of switched reluctance motor.
- To explain the performance and control of stepper motors, and their applications.
- To describe the operation and characteristics of permanent magnet dc motor.
- To distinguish between brush dc motor and brush less dc motor.
- To explain the theory of travelling magnetic field and applications of linear motors.

Unit I:
Permanent magnet materials and PMDC motors
Introduction-classification of permanent magnet materials used in electrical machines-minor hysteresis loop and recoil line-Stator frames of conventional dc machines-Development of electronically commutated dc motor from conventional dc motor-Permanent-magnet materials and characteristics-B-H loop and demagnetization characteristics-high temperature effects-reversible losses-Irreversible losses-Mechanical properties, handling and magnetization-Application of permanent magnets in motors-power density-operating temperature range-severity of operation duty.

Unit II:
Stepper Motors
Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two phase hybrid stepping motor.

Unit III:
Switched Reluctance Motors
Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs – Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

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Unit IV:
Permanent Magnet Brushless DC Motor
Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet DC Motors - Torque and EMF equations for Square wave & Sine wave for PMBLDC Motor – Torque - Speed characteristics of Square wave & Sine wave for PMBLDC Motor - Merits & demerits of Square wave & Sine wave for PMBLDC Motor - Performance and efficiency – Applications.

Unit V:
Linear Induction Motors (LIM)
Construction– principle of operation–Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one sided LIM with back iron- equivalent circuit of LIM.

Learning Outcomes:
After the completion of the course the student should be able to:

- distinguish between brush dc motor and brush less dc motor**.**
- explain the performance and control of stepper motors, and their applications.
- explain theory of operation and control of switched reluctance motor.
- explain the theory of travelling magnetic field and applications of linear motors.
- understand the significance of electrical motors for traction drives.

Text Books:
1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
2. Special electrical Machines, K.VenkataRatnam, University press, 2009, New Delhi.

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IV Year –II SEMESTER		L	T	P	C
		0	0	16	8
PROJECT-II					