DEPARTMENT OF
ELECTRICAL & ELECTRONICS ENGINEERING
COURSE STRUCTURE
&
SYLLABUS-R20
(Along with HONORS and MINORS)

(Applicable for batches admitted from 2020-2021)

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM *(A)*
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
VIZIANAGARAM - 535 003, ANDHRA PRADESH, INDIA

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

R20 Course Structure

Semester I (First Year)

S. No	Course Code	Course Title	L	T	P	C
1	R2011BS01	Calculus and Differential Equations	3	0	0	3
2	R2012BS04	Applied Physics	3	0	0	3
3	R2011ES13	Problem Solving and Programming using C	3	0	0	3
4	R2011ES02	Electrical Engineering Workshop	1	0	4	3
5	R2012ES04	Electrical Circuit Analysis-I	3	0	0	3
6	R2012ES05A	Basic Electrical Simulation Lab	0	0	3	1.5
7	R2012BS04A	Applied Physics Lab	0	0	3	1.5
8	R2011ES13A	Problem Solving and Programming using C Lab	0	0	3	1.5

Total Credits= 19.5

Semester II (First Year)

S. No	Course Code	Course Title	L	T	P	C
1	R2012BS02	Linear Algebra and Numerical Methods	3	0	0	3
2	R2011BS06	Applied Chemistry	3	0	0	3
3	R2012HS01	Communicative English	3	0	0	3
4	R2011ES11	Electronic Devices & Circuits	3	0	0	3
5	R2012ES06	Engineering Drawing	1	0	4	3
6	R2011BS06A	Applied Chemistry lab	0	0	3	1.5
7	R2012HS01A	English Communication Skills Lab	0	0	3	1.5
8	R2011ES11A	Electronic Devices & Circuits Lab	0	0	3	1.5
9	R2012MC01	Environmental Science	2	0	0	0

Total Credits = 19.5

Courses offered to other departments by EEE	
Basic Electrical & Electronics Engineering	CE, MECH, Metallurgy
Basic Electrical & Electronics Engineering lab	CE, MECH, Metallurgy
Basic Electrical Machines	ECE
Basic Electrical Machines lab	ECE

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R20 Course Structure

Semester III (Second Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R2021BS01	BSC	Vector Calculus, Transforms and PDE	3	0	0	3
2	R202102PC01	PCC	Electrical Circuit Analysis –II	3	0	0	3
3	R202102PC02	PCC	DC Machines & Transformers	3	0	0	3
4	R202102PC03	PCC	Electrical Measurements & Instrumentation	3	0	0	3
5	**R202102PC04**	PCC	Digital Electronics	3	0	0	3
6	R202102PC01A	PCC-LAB	Electrical Measurements & Instrumentation Lab	0	0	3	1.5
7	R202102PC02A	PCC-LAB	Electrical Circuits Lab	0	0	3	1.5
8	R202102PC03A	PCC-LAB	Digital Electronics Lab	0	0	3	1.5
9	R202102SC01	SC	Python Programming/ Certificate Course*	2	0	0	2
10	R2021MC01	MC	Professional Ethics & Human values	2	0	0	0
Total Credits-=21.5							

Note: * any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies asapproved by the BoS.

Category	Credits
Basic Science Course	03
Professional Core Courses	16.5
Skill Oriented Courses	02
TOTAL CREDITS	**21.5**

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R20 Course Structure

Semester IV (Second Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R202202ES01	ESC	Thermal & Hydro Prime Movers	3	0	0	3
2	R202202PC01	PCC	Control Systems	3	0	0	3
3	R202202PC02	PCC	Induction and synchronous machines	3	0	0	3
4	R202202PC03	PCC	Electrical power generation & economic concepts	3	0	0	3
5	R2022HS01	HSC	Management and organizational behavior	3	0	0	3
6	R202102ES01A	ES-LAB	Thermal & Hydro Prime Movers Lab	0	0	3	1.5
7	R202102PC01A	PCC-LAB	DC Machines and Transformers Lab	0	0	3	1.5
8	R202102PC02A	PCC-LAB	Control Systems Lab	0	0	3	1.5
9	R202202SC01	SC	Signals & Systems/ Certificate Course*	2	0	0	2
Total Credits=21.5							
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4
Internship 2 Months (Mandatory) during summer vacation							

Note: * any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies asapproved by the BoS.

Category	Credits
Humanities and Social Sciences	03
Professional Core Courses	12
Skill Oriented Courses	02
Engineering Science Courses	4.5
TOTAL CREDITS	**21.5**

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R20 Course Structure

Semester V (Third Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R203102PC01	PCC	Power Electronics	3	0	0	3
2	R203102PC02	PCC	Transmission & Distribution of Electrical Power	3	0	0	3
3	R203102PC03	PCC	Electromagnetic field theory	3	0	0	3
4	R203102OE01	OE/JOC	Open Elective -I	3	0	0	3
5	R203102PE01	PEC	Professional Elective-I	3	0	0	3
6	R203102PC01A	PCC-LAB	Induction and Synchronous Machines Lab	0	0	3	1.5
7	R203102PC02A	PCC-LAB	Electrical Simulation Lab	0	0	3	1.5
8	R203102SC01	SC	Advanced Communication Skills Lab -II/ Certificate Course on soft skills*	1	0	2	2
9	R2031MC01	MC	Indian constitution	2	0	0	0
Summer Internship 2 months (Mandatory) after second year (to be evaluated during V semester)				0	0	0	1.5
				Total Credits = 21.5			
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Note: * any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies asapproved by the BoS.

Category	Credits
Professional Elective Courses	03
Professional Core Courses	12
Open Elective Course/ Job oriented course	03
Skill advanced course/ Soft skill course	02
Summer Internship	1.5
TOTAL CREDITS	**21.5**

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ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

R20 Course Structure

Semester VI (Third Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R203202PC01	PCC	Microprocessors and Microcontrollers	3	0	0	3
2	R203202PC02	PCC	Power System Analysis	3	0	0	3
3	R203202PC03	PCC	Power system protection	3	0	0	3
4	R203202PE01	PEC	Professional Elective-II	3	0	0	3
5	R203202OE01	OE/JOC	Open Elective –II	3	0	0	3
6	R203202PC01A	PCC-LAB	Power Electronics Lab	0	0	3	1.5
7	R203202PC02A	PCC-LAB	Power Systems Lab	0	0	3	1.5
8	R203202PC03A	PCC-LAB	Microprocessors and Microcontrollers Lab	0	0	3	1.5
9	R203202SC01	SC	Renewable Energy Sources/ Certificate Course*	2	0	0	2
10	R2032MC01	MC	IPR & Patents	2	0	0	0
							Total Credits = 21.5

Note: * any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies asapproved by the BoS.

Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	**4**	**0**	**0**	**4**

Industrial/ Research Internship (Mandatory) 2 months during summer vacation

Category	Credits
Professional Elective Courses	03
Professional Core Courses	13.5
Open Elective Course/ Job oriented course	03
Skill advanced course/ Soft skill course	02
TOTAL CREDITS	**21.5**

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R20 Course Structure

Semester VII (Fourth Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R204102PE01	PEC	Professional Elective-III	3	0	0	3
2	R204102PE02	PEC	Professional Elective-IV	3	0	0	3
3	R204102PE03	PEC	Professional Elective-V	3	0	0	3
4	R204102OE01	OE/JOC	Open Elective -III	3	0	0	3
5	R204102OE02	OE/JOC	Open Elective -IV	3	0	0	3
6	R204102HS01	HSC	Universal Human Values-2: Understanding Harmony	3	0	0	3
7	R204102SC01	SC	Microgrid Technologies/ Certificate Course*	2	0	0	2
Industrial / Research Internship 2 months (Mandatory) after third year(to be evaluated during VII semester)				0	0	0	3
							Total Credits = 23
Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)				4	0	0	4

Note: * any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies asapproved by the BoS.

Category	Credits
Professional Elective Courses	09
Open Elective Course/ Job oriented course	06
Skill advanced course/ Soft skill course	02
Humanities and Social Science Elective	03
Industrial / Research Internship	03
TOTAL CREDITS	**23**

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R20 Course Structure

Semester VIII (Fourth Year)

S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R204202PR01	Major project/ PROJ	Project work, seminar and internship in industry	0	0	0	12
INTERNSHIP (6 MONTHS)							
Total Credits = 12							

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R20 Course Structure

List of Program Elective Subjects

Program Elective -I: (III-I)

1. Computer Organization
2. Renewable and Distributed Energy Technologies
3. JAVA Programming
4. Pulse and Digital Circuits
5. Linear IC Applications

Program Elective-II: (III-II)

1. Electrical Drives
2. Data Base Management Systems
3. Cyber Security
4. Cloud Computing
5. Operating Systems

Professional Elective – III: (IV-I)

1. Utilization of Electrical Energy
2. High Voltage Engineering
3. Smart Grid Technologies
4. Electrical Machine Modelling & Analysis
5. Advanced Control Systems

Professional Elective – IV: (IV-I)

1. Power System Operation and Control
2. Extra High Voltage AC Transmission
3. Flexible Alternating Current Transmission Systems
4. Energy Auditing & Demand side management
5. Power Quality

Professional Elective – V: (IV-I)

1. AI Applications in Electrical Engineering
2. Hybrid Electric Vehicles
3. IoT Applications in Electrical Engineering
4. Electrical Distribution Systems
5. Digital Control Systems

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R20 Course Structure

List of Open Elective Subjects offered by EEE Branch

Open Elective-I (III-I)

1. Non-Conventional Energy Sources
2. Basics of Control systems
3. Principles of Electric Power Conversion

Open Elective-II: (III-II)

1. Programmable Logic Controller and Applications
2. Energy Storage Systems
3. Soft Computing Techniques

Open Elective-III: (IV-I)

1. Electric Vehicles
2. Indian Electricity Act, 2003.
3. Power Systems for Data Centres

Open Elective-IV: (IV-I)

1.Concept of Power System Engineering
2.Fundamentals of Smart Grid Technologies
3. Electrical Power Distribution and Automation

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ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

Courses offered for HONORS Degree

Note:

1. The subjects opted for Honors should be advanced type which are not covered in regular curriculum
2. Students have to acquire 16 credits with minimum one subject from each pool.
3. Concerned BoS can add or delete the subjects as per the decision of the board.
4. Prerequisites to be defined by the board for each course.
5. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each)

POOL-1	**Pre-Requisites**
1. Advanced Power system protection	Switchgear and Protection
2. Power system reliability	Electrical Distribution Systems
3. Power Systems dynamics and Stability	Power System Analysis
4. Economic operation of Power system	Power System Operation and Control
POOL-2	**Pre-Requisites**
1. Advance Power Electronics	Power Electronics
2. Advanced Power Electronic Converters	Power Electronics
3. Power Quality & Custom Power devices	Power Quality
4. Automotive Power Electronics	Power Electronics
POOL-3	**Pre-Requisites**
1. Modern Control Systems	Control Systems
2. Discrete Control Systems	Digital Control Systems
3. Process Dynamics and Control	Control Systems
4. Optimal Control Theory	Optimization Techniques
POOL-4	**Pre-Requisites**
1. Advanced Electrical Machines	Electrical Machines
2. Special Electric Machines	Electrical Machines
3. Unified Theory of Electrical Machines	Machine Modelling and Analysis
4. Advanced Electric Drives	Electric Drives
POOL-5	**Pre-Requisites**
1. Distributed Generation & Micro grids	Renewable Energy Sources
2. Smart grid technologies	Renewable Energy Sources
3. Grid Integration of Renewable Energy Systems	Renewable Energy Sources
4. SCADA and Energy Management Systems	Electrical Distribution & Automation

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Minor Courses

S.No	Subject	L-T-P	Credit
	TRACK-1		
1.	Electrical Circuit Theory	**3-1-0**	**4**
2.	EMF Theory	**3-1-0**	**4**
3.	Control systems	**3-1-0**	**4**
	TRACK-2		
4.	Fundamentals of Electrical Machines	**3-1-0**	**4**
5.	Power Electronics	**3-1-0**	**4**
6.	Electrical Measurements & instrumentation	**3-1-0**	**4**
	TRACK-3		
7.	Electrical power generation & economic concepts	**3-1-0**	**4**
8.	Renewable Energy Sources	**3-1-0**	**4**
9.	Energy Storage Systems	**3-1-0**	**4**
	TRACK-4		
10.	Transmission and Distribution of Electrical Power	**3-1-0**	**4**
11.	Utilization of Electrical Energy	**3-1-0**	**4**
12.	Electrical Safety Course	**3-1-0**	**4**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-I Semester		**3**	**0**	**0**	**3**
Name of the Subject: Calculus and Differential Equations					

Course Objectives:

(i) This course will illuminate the students in the concepts of calculus.

(ii) To enlighten the learners in the concept of differential equations and multivariable calculus.

(iii) 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.

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

Sequences and Series: Convergence 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.

UNIT II: Differential equations: (15 hrs)

Linear differential equations – Bernoulli's equations – Exact equations and equations reducible to exact form

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^nV(x) – Method of Variation of parameters- Euler-Cauchy equation and Legender's equation

Applications: Orthogonal trajectories – Electrical circuits (RL, RC, RLC) – Simple Harmonic motion.

UNIT III: Partial differentiation: (10 hrs)

Introduction – Homogeneous function – Euler's theorem – Total derivative – Chain rule – Jacobian – Functional dependence – Taylor's and Mac Laurin'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 IV: Multiple integrals: (8 hrs)

Double integrals – Change of order of integration - Double integrals in polar coordinates- Areas enclosed by plane curves- Triple integrals – Volume of solids – Change of variables to polar, spherical and cylindrical co-ordinates.

Applications: Finding Areas and Volumes.

UNIT V: Beta and Gamma functions: (5 hrs)

Introduction to Improper Integrals-Beta and Gamma functions- Properties - Relation between Beta and Gamma functions- Evaluation of improper integrals.

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

(i) Utilize mean value theorems to real life problems (L3)
(ii) Solve the differential equations related to various engineering fields (L3).
(iii) Familiarize with functions of several variables which are useful in optimization (L3)
(iv) Apply double and triple integration techniques in evaluating areas and volumes bounded by region (L3)
(v) Conclude the use of Beta and Gamma functions in evaluating improper integrals (L4)

Text Books:

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

Reference Books:

i. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
ii. **Joel Hass, Christopher Heil and Maurice D. Weir,** Thomas calculus, 14th Edition, Pearson.
iii. **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press, 2013.
iv. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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		L	T	P	C
I Year-I Semester		**3**	**0**	**0**	**3**
Name of the Subject: APPLIED CHEMISTRY					

(Common to EEE,ECE,CSE,IT)

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.

Course Objectives:

i. ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
ii. ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
iii. ***Explain*** the preparation of semiconductors and nanomaterials, engineering applications of nanomaterials, superconductors and liquid crystals.
iv. ***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.
v. ***Outline*** the basics of computational chemistry and molecular switches

.

UNIT I: POLYMER TECHNOLOGY **8 hrs**

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.
Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).
Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).
Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION **10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).
Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

UNIT III: MATERIAL CHEMISTRY **10 hrs**

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 (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)
Liquid crystals:- Introduction-types-applications.
Super conductors:-Type –I, Type II-characteristics and applications

UNIT IV: SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES 10 hrs

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 differentiation of sp, sp^2, sp^3 and IR stretching of functional groups (alcohols, carbonyls, amines) 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.

UNIT V: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY 8 hrs

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies and its applications.
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

Course Outcomes

At the end of this unit, the students will be able to

(i) ***Analyze*** the different types of composite plastic materials and ***interpret*** the mechanism of conduction in conducting polymers.
(ii) ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
(iii) ***Synthesize*** nanomaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors.
(iv) ***Analyze*** the principles of different analytical instruments and their applications. Design models for energy by different natural sources.
(v) ***Obtain*** the knowledge of computational chemistry and molecular machines

Text Books:

i. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
ii. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
iii. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
iv. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference Books:

i. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
ii. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
iii. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
iv. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-I Semester		**3**	**0**	**0**	**3**
Problem Solving and Programming Using C					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To impart adequate knowledge on the need of programming languages and problem-solving techniques and develop programming skills.
ii. To enable effective usage of Control Structures and Implement different operations on arrays.
iii. To demonstrate the use of Strings and Functions.
iv. To impart the knowledge of pointers and understand the principles of dynamic memory allocation.
v. To understand structures and unions and illustrate the file concepts and its operations.

UNIT-I

Introduction to Computer Problem Solving: Programs and Algorithms, Computer Problem Solving Requirements, Phases of Problem Solving, Problem. Solving Strategies, Top-Down Approach, Algorithm Designing, Program Verification, Improving Efficiency, Algorithm Analysis and Notations.

UNIT-II

Introduction to C Programming: Introduction, Structure of a C Program. Comments, Keywords, Identifiers, Data Types, Variables, Constants, Input/output Statements. Operators, Type Conversion.
Control Flow, Relational Expressions: Conditional Branching Statements: if, if-else, if-else—if, switch. Basic Loop Structures: while, do-while loops, for loop, nested loops, The Break and Continue Statements, goto statement.

UNIT-III

Arrays: Introduction, Operations on Arrays, Arrays as Function Arguments, Two dimensional Arrays, Multi dimensional arrays.
Pointers: Concept of a Pointer, Declaring and Initializing Pointer Variables, Pointer Expressions and Address Arithmetic, Null Pointers, Generic Pointers, Pointers as Function Arguments, Pointers and Arrays, Pointer to Pointer, Dynamic Memory Allocation, Dangling Pointer, Command Line Arguments,

UNIT-IV

Functions: Introduction, Function Declaration, Function Definition, Function Call, Categories of Functions, Passing Parameters to Functions, Scope of Variables, Variable Storage Classes. Recursion.
Strings: String Fundamentals, String Processing with and without Library

Functions, Pointers and Strings.

UNIT-V

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type —Enum variables, Using Typedef keyword, Bit Fields.

Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Course Outcomes:

At the end of the Course, Student should be able to:

i. Illustrate the Fundamental concepts of Computers and basics of computer programming.
ii. Use Control Structures and Arrays in solving complex problems.
iii. Develop modular program aspects and Strings fundamentals.
iv. Demonstrate the ideas of pointers usage.
v. Solve real world problems using the concept of Structures, Unions and File operations.

Text Books:

i. How to solve it by Computer, R. G. Dromey, and Pearson Education.
ii. Computer Programming. Reema Thareja, Oxford University Press
iii. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.

Reference Books:

i. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
ii. Programming In C A-Practia1 Approach. Ajay Mittal, Pearson.
iii. C Programming — A Problem Solving Approach, Forouzan, Gilberg, Cengage.
iv. The C Programming Language, Dennis Richie And Brian Kernighan, Pearson Education.
v. Programming In C, Ashok Kamthane, Second Edition, Pearson Publication.

Web Links:

i. http://www.c4learn.com/
ii. http://www.geeksforgeeks.org/c/
iii. http://nptel.ac.in/courses/122104019/
iv. http://www.learn-c.org/
v. https://www.tutorialsyoint.com/cprogramming/

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year – I Semester		**L**	**T**	**P**	**C**
		1	**0**	**4**	**3**
	ELECTRICAL ENGINEERING WORKSHOP				

Course Objectives:

The objectives of this course is to acquire knowledge

i. on the usage of measuring equipment
ii. in setting up simple wiring circuits
iii. on semiconductor devices and their assembling.

Any 10 of the following experiments are to be conducted

1. Study of various electrical tools & symbols.
2. Study of different types of cable/wires and switches, fuses and fuse carries, MCB ELCB, RCCB and MCCB with their specifications and usage
3. Practicing color coding to identify resistors and capacitors and understanding the usage of digital multi-meter.
4. Practicing Tube Light Wiring scheme.
5. Practicing Stair Case Wiring scheme.
6. Practicing Godown Wiring scheme.
7. Study of Moving iron, Moving Coil, Electro-dynamic and Induction type meters.
8. Practicing power distribution arrangement scheme through single phase MCB distribution board with ELCB, main switch and energy.
9. Study of Energy meter.
10. Measurement of Power in AC Circuit.
11. Study of different types of Earthing.
12. Identification of different types of semiconductor devices.
13. Practicing (i) Soldering and De-soldering
    (ii) Assembling components on PCB.
14. Study of CRO.
15. Assembling and Verification of circuits using breadboard.
16. Study and understanding of name plate details of various appliances.

Course Outcomes:

The students should be able to:

i. understand the limitations, tolerance, safety aspects of electrical systems and wiring.

ii. select wires/cables and other accessories used in different types of wiring.
make simple lighting and power circuits.

iii. measure current, voltage and power in a circuit.

Text Books:

i. Experiments in Basic Electrical Engineering by S.K.Bhattacharya, Rastogi –New Age International Ltd.

ii. Electrical work shop By R.P.Singh, 2nd edition, I.K. International Publishing House Pvt. Limited

References:

i. Electrical Design Estimating and Costing By K.B. Raina & S.K.Bhattacharya
Residential and Commercial Industrial Electrical systems Vol.3 by Joshi-TMH

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year – I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
	ELECTRICAL CIRCUIT ANALYSIS-I				

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. concepts of passive elements, types of sources and various network reduction techniques and applications of electrical circuits.
ii. concept of magnetic coupled circuit.
iii. behavior of RLC networks for sinusoidal excitations.
iv. 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.
v. applications of network theorems for analysis of electrical networks.

UNIT-I

Introduction to Electrical Circuits

Basic Concepts of active and passive elements and their V-I relations, Sources (dependent and independent), Kirchhoff'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, Super node and Super mesh analysis, Principles of Duality.

UNIT-II

Magnetic Circuit

Basic definition of Magnetic Circuit, Magneto Motive Force, flux and reluctance - concept of self and mutual inductance, Dot convention – coefficient of coupling and composite magnetic circuit, Types of Coupling, analysis of series and parallel magnetic circuits.

UNIT-III

Single Phase A.C Systems

Periodic waveforms (determination of rms, average value, peak factor and form factor), concept of phase angle, phase difference – waveforms and phasor diagrams, lagging and leading networks, rectangular and polar forms of representations, steady state analysis of R, RL and RC circuits, power factor and its significance, real, reactive and apparent power, waveforms of instantaneous power and complex power.

UNIT-IV

Analysis of AC Networks

Extension of node and mesh analysis to AC networks, numerical problems on sinusoidal steady state analysis, series and parallel resonance, selectivity, band width and Quality factor, Current Locus diagrams of RL, RC and RLC circuits.

UNIT-V

Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum-power transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and Compensation theorem.

Course Outcomes:

The students should be able to:

i. analyze various electrical networks in presence of active and passive elements
ii. understand circuits with dot conventions.
iii. explore RLC networks with sinusoidal excitation.
iv. analyze resonance conditions in electrical circuits.
v. verify various network theorems.

Text Books:

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

Reference Books:

i. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India).
ii. Linear Circuit Analysis by De Carlo, Lin, Oxford publications.
iii. Electric Circuits – (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, adapted by K. Uma Rao, 5th Edition – McGraw Hill.
iv. Electric Circuits by David A. Bell, Oxford publications.
v. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications.
vi. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, Dhanpat Rai&Co.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year – I semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
	BASIC ELECTRICAL SIMULATION LAB (EEE)				

Course objectives:

The objectives of this course is to acquire knowledge on the

i. various basic operations on matrices.
ii. performance analysis of different types of periodic wave forms.
iii. principles of different types of theorems for analysis of networks.
iv. PN junction diode, half wave, full wave rectifiers and application of filters.

Any 10 of the following experiments are to be conducted

1. Practicing basic operations on Matrices.
2. Analysis of various signals and blocks (Addition, Subtraction, Integration and Differentiation, measurements etc.).
3. Generation of different types of Periodic waveforms (RMS, Average and Form Factor).
4. Verification of Kirchhoff's laws.
5. Steady State Response of Series and Parallel circuits.
6. Harmonic Analysis of periodic waveforms.
7. Verification of Superposition Theorem.
8. Verification of Thevenin's and Norton's Theorems.
9. Verification of Maximum Power Transfer Theorem.
10. Verification of Millman's Theorem.
11. Verification of Compensation Theorem.
12. Study of Diode characteristics. (Calculation of Diode Resistance)

Course Outcomes:

The student should be able to:

i. perform basic operations on matrices.
ii. verify different types of theorems on electrical networks.
iii. analyze the steady state performance of RLC Circuits.
iv. draw the characteristics of PN junction diode.

Textbooks:

i. Electronics & Circuit analysis using MATLAB, John O.Attia, CRC Press LLC, 1999

ii. Electric circuit fundamentals in MATLAB simulink , Mohammad Nuruzzaman

References:

i. MATLAB an introduction with applications, Amos Gilat, Wiley publications

ii. MATLAB Essentials for Problem Solving by Manoj khanna, Geeta Bhatt (author), Pawan kumar (author), PHI publications

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-I / II Semester		**0**	**0**	**3**	**1.5**
APPLIED PHYSICS LAB					

(Common to CSE, ECE, EEE & IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To **impart skills** in measurements with accurate error propagation.
ii. To **plan** the experimental procedure, **design** and to record and **analysis** results.
iii. To reach non trivial conclusions of significant of the experiments.
iv. To **develop** the skills to handle different instruments without taking erroneous readings and ability to enhance the skills to fabricate engineering and technical equipments.

List of experiments:

1. Determination of thickness of thin object by wedge method.
2. Determination of radius of curvature of a given plano convex lens by Newton's rings.
3. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
4. V-I Characteristics of a P-N Junction diode.
5. Determination of dielectric constant for different materials.
6. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
7. Determination of numerical aperture and acceptance angle of an optical fiber.
8. Determination of wavelength of Laser light using diffraction grating.
9. Estimation of Planck's constant using reverse photoelectric effect.
10. V-I Characteristics of a zener diode.
11. To determine the energy gap of a semiconductor using p-n junction diode.
12. Magnetic field along the axis of a current carrying circular coil by Stewart & Gee's Method.
13. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.
14. Measurement of resistance of a semiconductor with varying temperature.
15. Resistivity of a Superconductor using four probe method & Meissner effect.

Course Outcomes:

The students should be able to:

i. **Describe** the methodology of science and the relationship between observation and theory.
ii. **Develop** scientific problem solving skills, including organization of given information, identification and application of pertinent principles, quantitative solutions, interpreting results, and evaluating the validity of results.
iii. **Discover** of physics concepts in other disciplines such as mathematics, computer science, engineering, and chemistry.
iv. **Learn** to minimize contributing variables and recognize the limitations of equipment.

v. **Apply** conceptual understanding of the physics to general real-world situations.

vi. **Develop** interpersonal and communication skills including communicating in small groups, writing, working effectively with peers.

Reference Books:

i. S. Balasubramanian, M.N. Srinivasan "A Text Book of Practical Physics"- S Chand Publishers, 2017.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year-I Semester		L	T	P	C
		0	0	3	1.5
Problem solving and Programming using C lab					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

- To impart knowledge on basic Linux commands, various Editors, Raptor.
- To make the students understand the concepts of C programming.
- To nurture the students on Control Structures and develop different operations on arrays.
- To make use of String fundamentals and modular programming constructs.
- To implement programs using dynamic memory allocation.
- To explain the concepts of Structure, Unions and files for solving various problems.

List of Experiments:

1. Introduction to Algorithms and Flowcharts

1.1) Implement Algorithm Development for Exchange the values of Two numbers.

1.2) Given a set of n student's examination marks (in the range 0-100) make a count of the number of students that passed the examination. A Pass is awarded for all of 50 and above.

1.3) Given a set of n numbers design an algorithm that adds these numbers and returns the resultant sum. Assume N is greater than or equal to zero.

2. Introduction to C Programming

2.1) Basic Linux Commands.

2.2) Exposure to Turbo C, Vi, Emacs, Code Blocks IDE, Dev C++.

2.3) Writing simple programs using printf(), scanf() .

3. Raptor

3.1) Installation and Introduction to Raptor.

3.2) Draw a flow chart to find the Sum of 2 numbers.

3.3) Draw a flow chart to find Simple interest.

4. Basic Math

4.1) Write a C Program to convert Celsius to Fahrenheit and vice versa.

4.2) Write a C Program to find largest of three numbers using ternary operator.

4.3) Write a C Program to Calculate area of a Triangle using Heron's formula.

5. Control Flow- I

5.1) Write a C Program to Find Whether the Given Year is a Leap Year or not.

5.2) Write a C program to find the roots of a Quadratic Equation.

5.3) Write a C Program to make a simple Calculator to Add, Subtract, Multiply or Divide Using Switch...case.

6. Control Flow- II

6.1) Write a C Program to Find Whether the Given Number is Prime number or not.

6.2) Write a C Program to Find Whether the Given Number is Armstrong Number or not.

6.3) Write a C program to print Floyd Triangle.

7. Control Flow- III

7.1) Write a C program to find the sum of individual digits of a positive integer.

7.2) Write a C program to check whether given number is palindrome or not.

7.3) Write a C program to read two numbers, x and n, and then compute the sum of the geometric progression $1+x+x'+x^3+\ldots\ldots\ldots\ldots+x^n$.

8. Arrays

8.1) Write a C program to search an element in the given array (Linear Search).

8.2) Write a C program to perform matrix addition.

8.3) Write a C program to perform matrix multiplication.

9. Pointers

9.1) Write a C Program to Perform Addition. Subtraction, Multiplication and Division of two numbers using Command line arguments.

9.2) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.

9.3) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function.

10. Functions, Array & Pointers

10.1) Write a C Program to demonstrate parameter passing in Functions.

10.2) Write a C Program to find Fibonacci. Factorial of a number with recursion and without recursion.

10.3) Write a C Program to find the sum of given numbers with arrays and pointers.

11. Strings

11.1) Implementation of string manipulation operations with library function:

a. copy
b. concatenate
c. length
d. compare

11.2) Implementation of string manipulation operations without library function:

a. copy
b. concatenate
c. length
d. compare

12. Structures

12.1) Write a C Program to Store Information of a book Using Structure.

12.2) Write a C Program to Add Two Complex Numbers by Passing Structure to a Function.

13. Files

13.1) Write a C program to open a file and to print the contents of the file on screen.

13.2) Write a C program to copy content of one file to another file.

13.3) Write a C program to merge two files and store content in another file.

14. Application

Creating structures to capture the student's details save them in file in proper record format. search and prints the student details requested by the user.

Note: Draw the flowcharts using Raptor from Experiment 3 to Experiment 6.

Course Outcomes:

i. Implement basic programs in C and design flowcharts in Raptor.
ii. Use Conditional and Iterative statements to solve real time scenarios in C.
iii. Implement the concept of Arrays and Modularity and Strings.
iv. Apply the Dynamic Memory Allocation functions using pointers.
v. Develop programs using structures, and Files.

Text Books:

i. Let us C , Yaswanth Kanetkar, 16th Edition,BPB Publication.
ii. How to solve it by Computer, R. G. Dromey, and Pearson Education.
iii. Computer Programming. Reema Thareja, Oxford University Press

Reference Books:

i. Programming in C A-Practical Approach Ajay Mittal. Pearson Education.
ii. The C programming Language, Dennis Richie and Brian Kernighan, Pearson Education.
iii. Problem solving using C , K Venugopal,3'd Edition,TMG Publication.

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://raptor.martincar1is1e.com/
6. httos://npte1.ac.in/courses/106105055/2

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-II Semester		**3**	**0**	**0**	**3**
Name of the Subject: Linear algebra and Numerical Methods					

(Common to all branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) To instruct the concept of Matrices in solving linear algebraic equations

(ii) To elucidate the different numerical methods to solve nonlinear algebraic equations

(iii) To disseminate the use of different numerical techniques for carrying out numerical integration.

(iv) 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

UNIT – I: 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 linear equations – Gauss Elimination method – Eigenvalues and Eigen vectors and their properties.

Applications: Free vibration of a two-mass system.

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– Solutions of algebraic and transcendental equations : Bisection method–Secant method – Method of false position– Iteration method – Newton-Raphson method (One variable and simultaneous Equations)

Solutions of system of equations - Jacobi and Gauss-Seidel methods

Evaluation of largest eigenvalue –eigenvector using Power Method.

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 differential equations with initial conditions: **(10 hrs)**

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

Course Outcomes: The student will be able to

(i) Develop the use of matrix algebra techniques that is needed by engineers for practical applications (L6)
(ii) Solve system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel (L3)
(iii) Evaluate approximating the roots of polynomial and transcendental equations by different algorithms (L5)
(iv) Apply Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals (L3)
(v) Apply different algorithms for approximating the solutions of ordinary differential equations to its analytical computations (L3)

Text Books:

(i) **B. S. Grewal,** Higher Engineering Mathematics, 43^{rd} Edition, Khanna Publishers.
(ii) **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

(i) **David Poole,** Linear Algebra- A modern introduction, 4^{th} Edition, Cengage.
(ii) **Steven C. Chapra,** Applied Numerical Methods with MATLAB for Engineering and Science, Tata Mc. Graw Hill Education.
(iii) **M. K. Jain, S. R. K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation, New Age International Publications.
(iv) **Lawrence Turyn,** Advanced Engineering Mathematics, CRC Press.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-II Semester		**3**	**0**	**0**	**3**
Name of the Subject: APPLIED CHEMISTRY					

(Common to EEE,ECE,CSE,IT)

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.

Course Objectives:

i. ***Importance*** of usage of plastics in household appliances and composites (FRP) in aerospace and automotive industries.
ii. ***Outline*** the basics for the construction of electrochemical cells, batteries and fuel cells. Understand the mechanism of corrosion and how it can be prevented.
iii. ***Explain*** the preparation of semiconductors and nanomaterials, engineering applications of nanomaterials, superconductors and liquid crystals.
iv. ***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.
v. ***Outline*** the basics of computational chemistry and molecular switches

.

UNIT I: POLYMER TECHNOLOGY **8 hrs**

Polymerisation:- Introduction, methods of polymerization (emulsion and suspension), mechanical properties.
Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (PVC, polycarbonates and Bakelite), mention some examples of plastic materials used in electronic gadgets, recycling of e-plastic waste (waste to wealth).
Elastomers:- Introduction, preparation, properties and applications (Buna S, thiokol and polyurethanes).
Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers, biopolymers, biomedical polymers

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION **10 hrs**

Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).
Corrosion:-Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating [nickel]), Paints (constituents, functions and special paints).

UNIT III: MATERIAL CHEMISTRY **10 hrs**

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 (Brunauer Emmet Teller [BET]), (scanning electron microscopy [SEM]) and (transmission electron microscopy [TEM]), applications of graphene and fullerenes, carbon nanotubes (types, preparation and applications)
Liquid crystals:- Introduction-types-applications.
Super conductors:-Type –I, Type II-characteristics and applications

UNIT IV: SPECTROSCOPIC TECHNIQUES & NON-CONVENTIONAL ENERGY SOURCES 10 hrs

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 differentiation of sp, sp^2, sp^3 and IR stretching of functional groups (alcohols, carbonyls, amines) 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.

UNIT V: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY 8 hrs

Computational chemistry: Introduction to computational chemistry, molecular modelling and docking studies and its applications.
***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

Course Outcomes

At the end of this unit, the students will be able to

(i) ***Analyze*** the different types of composite plastic materials and ***interpret*** the mechanism of conduction in conducting polymers.
(ii) ***Utilize*** the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
(iii) ***Synthesize*** nanomaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors.
(iv) ***Analyze*** the principles of different analytical instruments and their applications. Design models for energy by different natural sources.
(v) ***Obtain*** the knowledge of computational chemistry and molecular machines

Text Books:

i. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
ii. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
iii. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
iv. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).

Reference Books:

i. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
ii. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
iii. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)
iv. B. S. Murthy, P. Shankar and others, "**Textbook of Nanoscience and Nanotechnology**", University press (latest edition)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year- I / II Semester		**3**	**0**	**0**	**3**
APPLIED PHYSICS					

(Common to CSE, ECE, EEE & IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications.
ii. Understand the mechanism of emission of light, utilization of lasers as coherent light sources for low and high energy applications, study of propagation of light through optical fibers and their implications in optical communications.
iii. Enlightenment of the concepts of Quantum Mechanics and to provide fundamentals of deBroglie matter waves, quantum mechanical wave equation and its application, the importance of free electron theory for metals and band theory for crystalline solids. Metals- Semiconductors-Insulators concepts utilization of transport phenomenon of charge carriers in semiconductors.
iv. To explain the significant concepts of dielectric and magnetic materials that leads to potential applications in the emerging micro devices.
v. To Understand the physics of Semiconductors and their working mechanism. To give an impetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

UNIT - I: Wave Optics **12 hrs**

Interference: Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colors in thin films- Newton's Rings- Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffraction - Fraunhofer diffraction due to single slit, double slit - N-slits (Qualitative) – Diffraction Grating - resolving power of Grating(Qualitative).

Polarization: Introduction-Types of polarization - Polarization by reflection and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

UNIT - II: Lasers and Fiber optics **8hrs**

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emissions of radiation – Einstein's coefficients and their relation – Population inversion – Lasing action - Pumping mechanisms – Ruby laser – He-Ne laser-Semiconductor laser - Applications of lasers.

Fiber optics: Introduction –Principle of optical fiber- Acceptance Angle - Numerical Aperture -Classification of optical fibers based on refractive index profile and modes –Block diagram of fiber optic communication.

UNIT - III: Quantum Mechanics, Free Electron Theory and Band theory **10hrs**

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well-Quantum tunnellinng effect (qualitative).

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory– Fermi energy-Equation for electrical conductivity based on quantum free electron theory –Fermi-Dirac distribution.

UNIT - IV: Dielectric and Magnetic Materials 8hrs

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility and Dielectric constant - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field- Clausius-Mossotti equation.
Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability - Origin of permanent magnetic moment - Classification of magnetic materials: Dia, para, Ferro, antiferro & Ferri magnetic materials - Domain concept for Ferromagnetism (Qualitative) - Hysteresis - soft and hard magnetic materials-Applications.

UNIT - V: Semiconductors and Superconductors 10hrs

Semiconductors: Introduction-Classification of solids - Intrinsic semiconductors – Density of charge carriers – Electrical conductivity – Fermi level – extrinsic semiconductors – density of charge carriers –Drift and diffusion currents – Einstein's equation- Hall effect – Hall coefficient –Applications of Hall effect.
Superconductors: Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory (Qualitative) – Josephson effects (AC and DC) – SQUIDs.

Course Outcomes:

The students should be able to:

i. **understand** the concepts of physical optics through the wave nature of light and **discuss** the phenomenal differences between interference, diffraction and polarization.

ii. **Describe** the basic laser physics, working of lasers, and principle of propagation of light in optical fibers.

iii. **Apply** the knowledge of basic quantum mechanics, to set up onedimensional Schrodinger's wave equation and **summarize** the importance of free electrons in determining the properties of metals.

iv. **explain** the basics of dielectric and magnetic materials to synthesize new materials as per needs of engineering applications.

v. gain the **knowledge** of semiconductor bonding, semiconductor carrier properties and phenomenological **describe** the phenomenon of superconduction

Text books:

i. M. N. Avadhanulu, P.G.Kshirsagar & TVS Arun Murthy" A Text book of Engineering Physics"- S.Chand Publications, 11th Edition 2019.
ii. Engineering Physics" by D.K.Bhattacharya and Poonam Tandon, Oxford press (2015).
iii. Applied Physics by P.K.Palanisamy SciTech publications.

Reference Books:

i. Fundamentals of Physics – Halliday, Resnick and Walker, John Wiley &Sons
ii. Engineering Physics by M.R.Srinivasan, New Age international publishers (2009).
iii. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education, 2018
iv. Engineering Physics - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press
v. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill
vi. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year – II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
	ELECTRONIC DEVICES AND CIRCUITS (EEE)				

Course objectives:

The objectives of this course is to acquire knowledge on the

i. The basic concepts of semiconductor physics are to be reviewed.
ii. Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
iii. The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed and the principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
iv. The need of transistor biasing and its significance is explained. The quiescent point or operating point is explained.
v. 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 and 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

UNIT-II:

Semiconductor Diodes:

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.

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

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 VBE, 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:

The Student should be able to

i. understand the concepts of Semiconductor Technology.
ii. appraise the construction & operation of electronic devices.
iii. develop the biasing circuits using the electronic devices.
iv. model the amplifier circuits.
v. analyse the characteristics of the devices.

Text Books:

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

References Books:

i. Electronic Devices and Circuits- Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, Second Edition..
ii. Electronic Devices and Circuits – David Bell, Oxford
iii. Electronic Devices and Circuits – An Introduction by Allen Mottershead, PHI publications

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-II Semester		**1**	**0**	**4**	**3**
Engineering Drawing					

Course Objectives:
The objectives of this course is to acquire knowledge on the
i. To introduce the students to use drawing instruments and to draw engineering curves.
ii. 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.
iii. The objective is to make the students draw the projections of the plane objects in different positions with the reference planes.
iv. 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.
v. 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.

UNIT - I:
Curves: Parabola, Ellipse and Hyperbola by general and special methods, cycloids, tangents & normals for the curves.
Scales: Plain scales, diagonal scales and vernier scales

UNIT - II:
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:

Polygons: Constructing regular polygons by general methods.

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:
Projections of Solids – Prisms, Pyramids, Cones and Cylinders with the axis inclined to one plane-Auxiliary views.

UNIT - V:
Conversion of isometric views to orthographic views and Conversion of orthographic views to isometric views.

Course Outcomes:
The students should be able to:
i. To make the student familiar with the techniques used for drawing various geometric elements used in engineering practice.

ii. The student can apply orthographic projections and project the points and lines parallel to one plane and inclined to both the planes.
iii. Prepare the drawings for construction of regular polygons and the projection of the planes inclined to both the planes.
iv. The student can prepare the drawings for the projections of the various types of solids in different positions inclined to one of the planes.
v. Ability to use the concepts of isometric views to orthographic views and vice-versa.

Text Books:

i. Engineering Drawing by N.D. Bhatt, Chariot Publications
ii. Engineering Drawing by Agarwal & Agarwal, Tata McGraw Hill Publishers

Reference Books:

i. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers
ii. Engineering Graphics for Degree by K.C. John, PHI Publishers
iii. Engineering Graphics by PI Varghese, McGrawHill Publishers
iv. Engineering Drawing + AutoCad – K Venugopal, V. Prabhu Raja, New Age

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		L	T	P	C
I Year-II Semester		**0**	**0**	**3**	**1.5**
Name of the Subject: APPLIED CHEMISTRY LAB					

(Common to EEE,ECE,CSE,IT)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i) Normality , molaritiy ,theory of indicators used in different volumetric and chemical analysis.

(ii) Alkalinity and hardness of water by E DTA method.

(iii) Volumetric analysis-Red-Ox titrations of different chemical compounds.

(iv) Determination of concentration of acids and bases using conductometer and potentiometer

(v) Determination of P^H and color metric analysis

Introduction to Chemistry laboratory – Molarities, 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^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method).
9. Determination of iso-electric point of amino acids using pH-metry method/conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Determination of Mg^{+2} present in an antacid.
13. Determination of $CaCO_3$ present in an egg shell.
14. Estimation of Vitamin C.
15. Determination of phosphoric content in soft drinks.
16. Adsorption of acetic acid by charcoal.

17. Preparation of nylon-6, 6 and Bakelite (demonstration only).

18. Determination of Lead in drinking water.

19. Determination of percentage of copper in Brass.

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

Course Outcomes:

(i) Student is exposed to volumetric titrations acquires some volumetric skills.

(ii) Student is able to analyze hard and soft water.

(iii) Student is exposed to volumetric skills of red-ox titrations with different indicators

(iv) Students can handle the instruments like conductometer, potentiometer in determinening the concentrations of acids and bases.

(v) Student is able to analyze the different chemical concentrations using colorimeter and P^H meter.

Reference Books

i.A Textbook of Quantitative Analysis, Arthur J. Vogel.

ii.Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year-II Semester		L	T	P	C
		0	0	3	1.5
ENGLISH COMMUNICATION SKILLS LAB					

(Common to all branches)

Course Objectives

(i) To impart grammar as well as communication through pronunciation. By introduction, pure vowels, consonants, diphthongs, phonetic transcription, common errors in pronunciation.

(ii) To impart better knowledge on Stress. Stress of kinds- mono syllabic, di syllabic, poly syllabic, strong and weak forms of stress along with contrastive stress.

(iii) To impart learner grammar as well as communication through compound words, rhythm, intonation and accent neutralization

(iv) To impart learner grammar as well as communication through listening, by identifying the context and specific pieces of information to answer a series of questions in speaking

(v) To improve the spoken skills of students by making them read news papers in order to understand and identify key terms context they read .

UNIT I:

Vowels, Consonants, Pronunciation, Phonetic Transcription, Common Errors in Pronunciation,

UNIT II:

Word stress-di-syllabic words, poly-syllabic words, weak and strong forms, contrastive stress (Homographs)

UNIT III:

Stress in compound words, rhythm, intonation, accent neutralisation.

UNIT IV:

Listening to short audio texts and identifying the context and specific pieces of information to answer a series of questions in speaking.

UNIT V:

Newspapers reading; Understanding and identifying key terms and structures useful for writing reports.

Course Outcomes:

At the end of the module, the learners will be able to

(i) The learner will improve phonetic understanding, transcription, common errors both in pronunciation and written English.

(ii) The learner will improve syllabic division, and how to use right stress in their pronunciation.

(iii) The learner will improve speaking skills with right intonation and rhythm and intonation and how to reduce mother tongue influence in English.

(iv) The learner will Improve speaking skills as well as listening skills by listening through the audio clips prescribed.

(v) The learner will Improve speaking skills along with reading skills.

Prescribed text book:

(i) "**InfoTech English**", Maruthi Publications.

References:

i. Exercises in Spoken English Part 1,2,3,4, OUP and CIEFL.
ii. English Pronunciation in use- Mark Hancock, Cambridge University Press.
iii. English Phonetics and Phonology-Peter Roach, Cambridge University Press.
iv. English Pronunciation in use- Mark Hewings, Cambridge University Press.
v. English Pronunciation Dictionary- Daniel Jones, Cambridge University Press.
vi. English Phonetics for Indian Students- P. Bala Subramanian, Mac Millan Publications.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

I Year – II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
	ELECTRONIC DEVICES AND CIRCUITS LABORATORY (EEE)				

Course objectives:
The objectives of this course is to acquire knowledge on the

i. identification, specifications, testing of R, L, C Components (Colour Codes), Potentiometers, Coils, Gang condensers, Relays, Bread Boards.
ii. identification, specifications, testing of active devices, Diodes, BJTs, JFETs, LEDs, LCDs, SCR, UJT.
iii. Soldering practice-simple circuits using active and passive components.
iv. Study and operation of Ammeters, Voltmeters, Transformers, Analog and Digital Multimeter, Function Generator, Regulated Power Supply and CRO.

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.

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. V-I Characteristics of Zener Diode
3. Zener Diode as Voltage Regulator
4. Half and Full wave Rectifiers (without and with c-filter)
5. BJT Characteristics (CE Configuration)

Part A: Input Characteristics

Part B: output Characteristics

6. BJT Characteristics (CB Configuration)

Part A: Input Characteristics

Part B: output Characteristics

7. FET Characteristics

Part A: Drain Characteristics

Part B: Transfer Characteristics

8. Transistor Biasing
9. BJT-CE Amplifier

10. Emitter Follower –CC Amplifier
11. FET-CS Amplifier
12. Class – A Amplifier

Text Books:

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

References Books:

i. Electronic Devices and Circuits- Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, Second Edition.
ii. Electronic Devices and Circuits – David Bell, Oxford.
iii. Electronic Devices and Circuits – An Introduction by Allen Mottershead, PHI publications.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
I Year-I/II Semester		**2**	**0**	**0**	**0**
Name of the Subject: Environmental Science					

(Common to All branches)

Course Objectives:

The objectives of this course is to acquire knowledge on the

(i)The natural resources and their sustenance of the life and recognize the need to conserve the natural resources.

(ii)The concepts of ecosystem and its functions in the environment. The need for protecting the producers and consumers and their role in the food web.

(iii)The biodiversity of India and the threats to biodiversity, and the conservation practices to protect the biodiversity.

(iv)Various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management.

(v)Social issues both rural and urban environment and the possible means to combat the challenges.

UNIT - I: MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 7hrs

Definition, Scope and Importance - Need for public Awareness.

Natural Resources : Renewable and non-renewable 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 - 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 agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity.

UNIT - II: ECOSYSTEMS, BIODIVERSITY AND ITS CONSERVATION 7hrs

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 the ecosystems.

Biodiversity and its Conservation : Definition: genetic, species and ecosystem diversity – Bio geographical classification of India - Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT - III Environmental Pollution and solid waste Management 6hrs

Environmental pollution: Definition, Cause, effects and control measures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, nuclear hazards.

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes -Role of an individual in prevention of pollution, Disaster management: floods, earthquake, cyclone and landslides.

UNIT - IV: SOCIAL ISSUES AND THE ENVIRONMBNT 6hrs

Social Issues and the Environment: From Unsustainable to Sustainable development - 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 - Climate change, global warming, acid rain and ozone layer depletion, Wasteland reclamation – Consumerism and waste products. - Environment Protection Act. - Air (Prevention and Control of Pollution) Act. -Water (prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act.

UNIT - V: HUMAN POPULATION AND THE ENVIRONMENT 6hrs

Human population and the Environment: Population growth, variation among nations' Population explosion - Family Welfare programme. - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of information Technology in Environment and human health.

Field Work: Visit to a local area to document environmental assets River/forest

Grassland/hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds - river, hill slopes.

Course Outcomes:

The students should be able to:

(i)Gain a higher level of personal involvement and interest in understanding and solving environmental problems.

(ii)Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities.

(iii)Demonstrate knowledge relating to the biological systems involved in the major global environmental problems of the 2lst century.

(iv) Influence their society in proper utilization of goods and services, Recognize the interconnectedness of human dependence on the earth's ecosystems.

(v)Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.

Text Books:

(i)Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.

(ii)Environmental Studies by Palaniswamy - Pearson education.

(iii)Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company.

Reference Books:

(i)Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.

(ii)Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.

(iii)Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.

(iv) Environmental sciences and engineering - J. Glynn Henry and Gary W. Heinke – Prentice hall India Private limited.

(v) A Text Book of Environmental Studies by G.R.Chatwal, Himalaya Publishing House.

(vi) Introduction to Environmental engineering and science by Gilberl M. Masters and Wendell P.Ela - Prentice hall of India Private limited

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Vector Calculus, Transforms and PDE					

Course Objectives:

(i) To familiarize the techniques in partial differential equations

(ii) To furnish the learners with basic concepts and techniques of vector calculus and apply to various real world applications

(iii) To understand the signal processing using Fourier series and transforms

UNIT – 1: Vector calculus:

Differentiation of vectors – Scalar and vector point functions – Gradient – Directional derivative – Divergence – Curl.

Integration of vectors - Line integral – Circulation - Work done – Surface integral – Flux – Volume integral - Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and their applications.

UNIT – II: Laplace Transforms:

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

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

UNIT – III: Fourier series and Fourier Transforms:

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: Partial differential equations of first order:

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:

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.

Course Outcomes:

The students should be able to:

(vi) Interpret the physical meaning of different operators such as gradient, curl and divergence Estimate the work done against a field, circulation and flux using vector calculus

(vii) Apply the Laplace transform for solving differential equations

(viii) Find or compute the Fourier series of periodic signals

(ix) Know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms

(x) Identify solution methods for partial differential equations that model physical processes

Text Books:

(i) **B. S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.

(ii) **B. V. Ramana,** Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

(i) **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.

(ii) **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.

(iii) **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.

Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
ELECTRICAL CIRCUITS ANALYSIS-II					

Course Objectives:

The objective of this course is to acquire knowledge on

i. concepts of balanced and unbalanced three-phase circuits.
ii. transient behavior of electrical networks with DC, pulse and AC excitations.
iii. performance of a network based on input and output excitation/response.
iv. realization of electrical network function into electrical equivalent passive elements.
v. application of Fourier series and Fourier transforms for analysis of electrical circuits.

UNIT-I Balanced and Unbalanced Three phase circuits

Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three phase circuits, measurement of active and reactive power.

Analysis of three phase 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, ABCD and Hybrid parameters and their relations, cascaded networks, poles and zeros of network functions.

UNIT-IV Network synthesis

Positive real function – basic synthesis procedure – LC immittance functions – RC impedance functions and RL admittance function – RL impedance function and RC admittance function – Foster and Cauer methods.

UNIT-V Fourier analysis and Transforms

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.

Fourier integrals and Fourier transforms – properties of Fourier transforms physical significance of the Fourier transform and its application to electrical circuits.

Course Outcomes:

The Student should be able to

i. solve three- phase circuits under balanced and unbalanced condition
ii. find the transient response of electrical networks for different types of excitations.
iii. find parameters for different types of network.
iv. realize electrical equivalent network for a given network transfer function.
v. extract different harmonics components from the response of an electrical network.

Text Books:

i. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company,6 th edition
ii. Network synthesis: Van Valkenburg: Prentice-Hall of India Private Ltd.

Reference Books:

i. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India)
ii. Introduction to circuit analysis and design by TildonGlisson. Jr, Springer Publications.
iii. Circuits by A.Bruce Carlson , Cengage Learning Publications
iv. Network Theory Analysis and Synthesis by SmarajitGhosh, PHI publications
v. Networks and Systems by D. Roy Choudhury, New Age International publishers
vi. Electric Circuits by David A. Bell, Oxford publications
vii. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi,DhanpatRai&Co.

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II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
DC MACHINES AND TRANSFORMERS					

Course Objectives:

The objective of this course is to acquire knowledge on

i. construction and principle of dc machines.
ii. characteristics, performance, methods of speed control and testing methods of dc motors.
iii. to predetermine the performance of single phase transformers with equivalent circuit models.
iv. methods of testing of single-phase transformer.
v. 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 – lagging, leading and unity power factors loads –phasor diagrams of transformers – equivalent circuit – regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency.

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 – equivalent circuit – comparison with two winding transformers.

Course outcomes:

The student should be able to

i. assess the operation of DC Machines
ii. mitigate the ill-effects of armature reaction and improve commutation in dc machines.
iii. perform the torque production mechanism and control the speed of dc motors.
iv. analyze the performance of single phase transformers.
v. parallel transformers, control voltages with tap changing methods and achieve three-phase to two-phase transformation.

Text Books:

i. Electrical Machines by P.S. Bhimbra, Khanna Publishers
ii. Electric Machinery by A.E.Fitzgerald,Charleskingsley,StephenD.Umans, TMH

Reference Books:

i. Electrical Machines by D. P.Kothari, I .J .Nagarth,McGraw Hill Publications, 4th edition
ii. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition.
iii. Electrical Machinery by AbijithChakrabarthi and SudhiptaDebnath, McGraw Hill education 2015
iv. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
v. Electric Machines by Mulukutla S.Sarma & Mukeshk.Pathak, CENGAGE Learning.
vi. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
ELECTRICAL MEASUREMENTS AND INSTRUMENTATION					

Course Objectives:

The objective of this course is to acquire knowledge on

i. classification and usage of various meters to measure current & voltage
ii. applications of potentiometers & instrument transformers.
iii. measurement of active power, reactive power and energy
iv. resistance, inductance and capacitance measuring methods.
v. characteristics and applications of transducers.

UNIT – I: Introduction to measuring instruments:

Classification-deflecting, control and damping torques-Ammeters and Voltmeters-PMMC, moving iron type instruments- expression for the deflecting torque and control torque-errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type-Extension of range of E.S. Voltmeters

UNIT – II: Potentiometers & Instrument Transformers:

Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate types standardization –applications. CT and PT – Ratio and phase angle errors

UNIT - III: Measurement of Power & Energy:

Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Singlephase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri vector meter, maximum demand meters.

UNIT - IV DC & AC Bridges:

Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle - Desauty bridge, Wien's bridge –Schering Bridge.

UNIT-V: Transducers:

Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes.

Course Outcomes:

The student should be able to

compare the different types of measuring instruments, their construction, operation and characteristics.
measure the voltage and current through potentiometers and instrument transformers
choose the suitable method for measurement of active, reactive powers and energy.
apply the suitable method for measurement of resistance, inductance and capacitance.
apply the knowledge about transducers effectively.

Text Books:

i. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications
ii. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
iii. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:

i. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
ii. Electrical Measurements by Buckingham and Price, Prentice – Hall
iii. Electrical Measurements by Forest K. Harris. John Wiley and Sons
iv. Electrical Measurements: Fundamentals, Concepts, Applications byReissland, M.U, New Age International (P) Limited, Publishers.
v. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

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UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
DIGITAL ELECTRONICS					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
ii. logical operations using combinational logic circuits
iii. sequential logic circuits and synchronous state machines using flip-flops.
iv. process of Analog to Digital conversion and Digital to Analog conversion
v. different semiconductor memories and PLDs to implement the given logical problem

UNIT – I: Fundamentals of Digital Systems and Logic Families: Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

UNIT – II: Combinational Digital Circuits: Standard representation for logic functions, K-map representation and simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial ladder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

UNIT – III: Sequential Circuits and Systems: A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J, K, T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

UNIT–IV: A/D and D/A Converters: Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter

UNIT–V: Semiconductor Memories and Programmable Logic Devices: Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge decoupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Course Outcomes:

The student should be able to

i. design of digital circuits and fundamental concepts used in the design of digital systems.
ii. analyze the logical operations using combinational logic circuits
iii. assess sequential logic circuits and synchronous state machines using flip-flops.
iv. know the fundamental process of Analog to Digital conversion and Digital to Analog conversion
v. differentiate semiconductor memories and PLDs to implement the given logical problem

TEXT BOOKS:

i. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
ii. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

REFERENCE BOOK:

i. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

Course Objectives:

II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB					

The objectives of this course is to acquire knowledge on

i. function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy,
ii. measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
iii. testing of transformer oil.
iv. calibration and working of energy meter

List of experiments

Any 10 of the following experiments are to be conducted

1. Calibration and Testing of single phase energy meter
2. Calibration of dynamometer wattmeter using phantom loading
3. Calibration of PMMC ammeter and voltmeter using Crompton D.C. Potentiometer
4. Measurement of resistance and Determination of Tolerance using Kelvin's double Bridge.
5. Capacitance Measurement using Schering bridge.
6. Inductance Measurement using Anderson bridge.
7. Measurement of 3 phase reactive power with single phase wattmeter for balanced loading.
8. Calibration of LPF wattmeter by direct loading.
9. Measurement of 3 phase power with single watt meter and using two C.Ts.
10. Testing of C.T. using mutual inductance method.
11. Testing of P.T. using absolute null method.
12. Dielectric oil testing using H.T test Kit.
13. Calibration of AC voltmeter and measurement of choke parameters using AC Potentiometer in polar form.

Course Outcomes:

The students should be able to:

i. measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
ii. test transformer oil for its effectiveness.
iii. measure the parameters of inductive coil
iv. calibrate wattmeter, voltmeter and energy meter.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
ELECTRICAL CIRUCITS LAB					

Course Objectives:

The objectives of this course is to acquire knowledge

i. To verify and demonstrate various theorems, locus diagrams, resonance and two port networks.
ii. 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) Locus diagrams of RL and RC series circuits
6) Series and parallel resonance
7) Determination of self, mutual inductances and coefficient of coupling
8) Determination of impedance (Z) and Admittance (Y) Parameters
9) Determination of Transmission and hybrid parameters
10) Determination of 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

Course outcomes:

The Student should be able to

i. apply various theorems, determination of self and mutual inductances, two port parameters of a given electric circuits.
ii. draw locus diagrams, waveforms and phasor diagrams for lagging and leading networks.

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II Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
DIGITAL ELECTRONICS LAB					

Course Objectives:

The objective of this course is to acquire knowledge to

i. Verify of truth tables of Logic gates.
ii. Verify of functional table of 3 to 8 line Decoder /De-multiplexer.
iii. Design full adder circuit and verify its functional tables .
iv. Verify of functional tables of Flip-Flops..

List of Experiments: (Minimum of Twelve Experiments has to be performed)

1. Verification of truth tables of Logic gates Two input
(i) OR (ii) AND (iii) NOR (iv) NAND (v) Exclusive OR (vi) Exclusive NOR
2. Design a simple combinational circuit with four variables and obtain minimal SOP expression and verify the truth table using Digital Trainer Kit
3. Verification of functional table of 3-to-8-line Decoder /De-multiplexer
4. 4 variable logic function verification using 8 to 1multiplexer.
5. Design full adder circuit and verify its functional table.
6. Verification of functional tables of
(i) J K Edge triggered Flip –Flop
(ii) J K Master Slave Flip – Flop (iii)D Flip -Flop
7. Design a four-bit ring counter using D Flip – Flops / JK Flip Flop and verify output
8. Design a four-bit Johnson's counter using D Flip-Flops / JK Flip Flops and verify output
9. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.
10. Draw the circuit diagram of MOD-8 ripple counter and construct a circuit using T-Flip-Flops and Test it with a low frequency clock and Sketch the output waveforms.
11. Design MOD – 8 synchronous counter using T Flip-Flop and verify the result and Sketch the output waveforms.
12. (a) Draw the circuit diagram of a single bit comparator and test the output
(b) Construct 7 Segment Display Circuit Using Decoder and 7 Segment LED and test it.

Course Outcomes:

The students shall be able to

i. applications of truth tables of Logic gates.
ii. analyse of functional table of 3 to 8 line Decoder /De-multiplexer.
iii. demonstrate full adder circuit and verify its functional tables .
iv. applications of functional tables of Flip-Flops

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II Year-I Semester	**SKILL ORIENTED COURSE**				
PYTHON PROGRAMMING		**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objectives:

i. To know the basics of algorithmic problem solving
ii. To read and write simple Python programs.
iii. To develop Python programs with conditionals and loops.
iv. To use Python data structures –- lists, tuples, dictionaries.
v. To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING

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

UNIT II DATA, EXPRESSIONS, STATEMENTS

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

UNIT III CONTROL FLOW, FUNCTIONS

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

UNIT IV LISTS, TUPLES, DICTIONARIES

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;19 Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES

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

Course Outcomes:

Upon completion of the course, students will be able to

i. Develop algorithmic solutions to simple computational problems
ii. Read, write, execute by hand simple Python programs.
iii. Decompose a Python program into functions.
iv. Represent compound data using Python lists, tuples, dictionaries.
v. Read and write data from/to files in Python Programs.

TEXT BOOKS:

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

REFERENCES:

i. Charles Dierbach, "Introduction to Computer Science using Python: A Computational
ii. Problem-Solving Focus, Wiley India Edition, 2013.
iii. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised
iv. and expanded Edition, MIT Press , 2013
v. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
vi. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction
vii. to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.
viii. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in
ix. Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
x. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - I Semester		**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
PROFESSIONAL ETHICS AND HUMAN VALUES (MC)					

Course Objectives:

i. This course is aimed at familiarizing researchers with the nuances of Intellectual Property Rights (IPR) so as to help them integrate the IPR process in their research activities.
ii. IPR internalization process to help the researchers to set targeted objectives in their research project and also to design and implement their research to clearly differentiate their work vis-a-vis the existing state of knowledge/ prior art.
iii. To give the PhD Students "hands- on –training" in literature, including patent search and documentation of research activities that would aid an IPR expert to draft, apply and prosecute IPR applications.
iv. To make the PhD students familiar with basics of IPR and their implications in Research, development and commercialization.
v. Facilitate the students to explore career options in IPR.

Unit I: Introduction to Intellectual Property Rights (IPR)

Introduction of IPR - Importance - Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing —

Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations

UNIT IV: Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT V: Trade Secrets & Cyber Law and Cyber Crime

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets – Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law. Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions – E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

Course Outcomes:

i. IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.
ii. Student gets an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.
iii. Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyse the social impact of intellectual property law and policy
iv. Analyse ethical and professional issues which arise in the intellectual property law context
v. students should be able to Write reports on project work and critical reflect on their own learning.

References:

i. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.
ii. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.
iii. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi
iv. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.
v. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).
vi. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.
vii. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.
viii. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
THERMALAND HYDRO PRIME MOVERS					

Course Objectives:
The students will acquire the knowledge:

i. To understand the basic concepts of steam power cycle and steam turbines
ii. To understand the fundamental concepts of IC engines and gas turbines
iii. To understand the principles involved in the impact of jets and basic concepts of centrifugal pumps
iv. To understand the basic concepts in working of the hydraulic turbines and their performance.
v. To understand the functions of components of hydro electric power plant

UNIT I:

STEAM POWER
Properties of Steam and use of Steam Tables-T-S and H-S Diagrams. Analysis of Various Thermodynamic 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

UNIT II:

I.C ENGINES: Classification, working principles – valve and port timing diagrams – air standard cycles-Otto, Diesel and Dual cycles – Engine systems, fuel injection, carburetion, ignition, cooling and lubrication – Engine performance evaluation.

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.

UNIT III:

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

UNIT V:

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.

Course Outcomes:

After undergoing the course the student is expected to learn

i. Illustrate the basic concepts of steam power cycle and steam turbines
ii. Understand the fundamental concepts of IC engines and gas turbines
iii. Interpret the principles involved in the impact of jets and basic concepts of centrifugal pumps
iv. Illustrate the basic concepts in working of the hydraulic turbines and their performance.
v. Interpret the functions of components of hydro electric power plant

Text Books:

i. Thermal Engineering by Rajput, Lakshmi publications
ii. Thermal engineering by M.L.Mathur and F.S.Mehta, Jain Brothers.
iii. "Hydraulics & Fluid Mechanics", P.N. Modi and S.M. Seth, TEXT BOOKS House, Delhi
iv. "Fluid Mechanics & Hydraulic Machinery" A.K.Jain, , Khanna Publishers, Delhi.

Reference Books:

i. "Fluid Mechanics" by Victor.L.Streeter
ii. "Introduction to Fluid Mechanics" Edward .J. Shaughnessy Jr.
iii. "Fluid Mechanics & Its Applications", Vijay Gupta, Santhosh.k.Gupta
iv. "Fluid Mechanics & Fluid power Engineering, Dr D.S.Kumar
v. "Water Power Engineering" M.M Desumukh

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
CONTROL SYSTEMS					

Course Objectives:

The objective of this course is to acquire knowledge on

i. mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
ii. time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers and to investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
iii. Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
iv. basic aspects of design and compensation of linear control systems using Bode plots.
v. state models and analyze the systems and also 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, effects of proportional (P), proportional-integral (PI), proportional-integral-derivative (PID) systems.

Stability and root locus technique

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 to the transfer function.

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.

Course Outcomes:

The student should be able to

i. derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
ii. determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
iii. analyze the stability of LTI systems using frequency response methods.
iv. design Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
v. represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:

i. Control Systems principles and design by M.Gopal, Tata McGraw Hill education Pvt Ltd., 4th Edition.
ii. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

i. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
ii. Control Systems by ManikDhanesh N, Cengage publications.
iii. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
iv. Control Systems Engineering by S.Palani, Tata McGraw Hill Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
INDUCTION AND SYNCHRONOUS MACHINES					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. principle of operation and performance of 3-phase induction motor.
ii. performance of induction motor in terms of torque and slip.
iii. torque producing mechanism of a single-phase induction motor.
iv. various performance parameters of Synchronous Machines
v. 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 pf 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 – starting methods, AC series motor.

UNIT–IV:

Construction, operation, voltage regulation and parallel operation 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.

Course Outcomes:

The student should be able to

i. explain the operation and performance of three phase induction motor.
ii. analyze the torque-speed relation, performance of induction motor and induction generator.
iii. implement the starting of single phase induction motors.
iv. to perform winding design and predetermine the regulation of synchronous generators.
v. avoid hunting phenomenon, implement methods of staring and correction of power factor with synchronous motor.

Text Books:

i. Electrical Machines by P.S. Bhimbra, Khanna Publishers
ii. Electric Machinery by A.E.Fitzgerald, Charles kingsley, Stephen D.Umans, TMH

Reference Books:

i. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 4th edition
ii. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition
iii. Electrical Machinery by AbijithChakrabarthi and SudhiptaDebnath, McGraw Hill education 2015
iv. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2010
v. Electric Machines by MulukutlaS.Sarma&Mukeshk.Pathak, CENGAGE Learning.
vi. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons
vii. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House
viii. Performance and design of AC machines – M.G. Say.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
ELECTRICAL POWER GENERATION AND ECONOMIC ASPECTS					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. principle of operation of different components of a thermal power stations.
ii. principle of operation of different components of a Nuclear power stations.
iii. constructional and operation of different components of an Air and Gas Insulated substations.
iv. constructional details of different types of cables.
v. 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.

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.

Course Outcomes:

The student should be able to

i. differentiate the components of thermal power plants.
ii. assess different components of nuclear power plants.
iii. identify the different components of air and gas insulated substations.
iv. explicit the single core and three core cables with different insulating materials.
v. analyse the different economic factors of power generation and tariffs.

Text Books:e

i. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand , A. Chakrabarti, DhanpatRai& Co. Pvt. Ltd.
ii. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.

Reference Books:

i. Electrical Power Distribution Systems by V. Kamaraju, TataMcGraw Hill, New Delhi.
ii. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MANAGEMENT AND ORGANIZATIONAL BEHAVIOR					

Course Objectives:

i. To familiarize with the process of management, principles, leadership styles and basic concepts on Organisation.
ii. To know how to apply basic knowledge of statistics in quality control and to study about the inventory management.
iii. To provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
iv. To provide basic insight into Strategic Management and corporate planning with SWOT analysis.
v. To know about the contemporary management practices in the globalised era.

Unit I

Introduction: Management and organizational concepts of management and organization- Nature and Importance of Management, Functions of Management, System approach to Management - Taylor's Scientific Management Theory, Fayol's Principles of Management, Leadership Styles, Social responsibilities of Management. Designing Organizational Structures: Basic concepts related to Organization - Departmentation and Decentralization, MBO, Process and concepts.

Unit II

Functional Management: Human Resource Management (HRM) Concepts of HRM, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating. - Marketing Management: Concepts of Marketing, Marketing mix elements and marketing strategies.

Unit III

Strategic Management: Strategic Management and Contemporary Strategic Issues: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and implementation, Generic Strategy alternatives. Bench Marking, Balanced Score Card and other Contemporary Business Strategies.

Unit IV

Individual Behavior: Perception-Perceptual process- Impression management- Personality development – Socialization – Attitude- Process- Formation- Positive attitude- Change – Learning – Learning organizations-

Reinforcement Motivation – Process- Motives – Theories of Motivation: Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation,

Unit V

Group Dynamics: Types of Groups, Stages of Group Development, Group Behaviour and Group Performance Factors, Organizational conflicts: Reasons for Conflicts, Consequences of Conflicts in Organization, Types of Conflicts, Strategies for Managing Conflicts, Organizational Climate and Culture, Stress, Causes and effects, coping strategies of stress.

Course Outcomes:

i. To familiarize with the process of management, principles, leadership styles and basic concepts on Organization.
ii. To know how to apply basic knowledge of statistics in quality control and to study about the inventory management.
iii. To provide conceptual knowledge on functional management that is on Human resource management and Marketing management.
iv. To provide basic insight into Strategic Management and Corporate planning with SWOT analysis.
v. To know about the contemporary management practices in the globalised era.

Reference Books:

i. Subba Rao P., *Organizational Behaviour*, Himalaya Publishing House. Mumbai.
ii. Fred Luthans *Organizational Behaviour*, TMH, New Delhi.
iii. Robins, Stephen P., *Fundamentals of Management*, Pearson, India.
iv. Kotler Philip & Keller Kevin Lane: Marketing Mangement 12/e, PHI, 2007
v. Koontz & Weihrich: *Essentials of Management*, 6/e, TMH, 2007
vi. Kanishka Bedi, *Production and Operations Management*, Oxford University Press, 2007

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
THERMAL AND HYDRO PRIME MOVERS LAB					

Course Objectives: The Students will acquire the knowledge

i. To identify the valves and ports opening and closing of IC engines
ii. To find the performance characteristics and frictional power of an internal combustion engines
iii. To understand the finding out the frictional power, preparation of heat balance sheet, conduction of economical speed test and basic components of boilers
iv. To identify the coefficient discharge of venturimeter and orifice meter.
v. To find the performance of hydraulic turbines and pumps.
vi. To identify the minor losses of the fluid flow through pipes.

NOTE: To conduct a minimum of 12 experiments 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 FHP by retardation and motoring test on IC engine
6. I.C. Engines 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.
10. Performance Test on Multi Stage Centrifugal Pump.

Course Outcomes:

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

i. Identify the valves and ports opening and closing of IC engines (BL-3)
ii. Find the performance characteristics and frictional power of an internal combustion engines (BL1)
iii. Understand the finding out the frictional power, preparation of heat balance sheet, conduction of economical speed test and basic components of boilers (BL-1)
iv. Identify the coefficient discharge of venturimeter and orifice meter
v. Find the performance of hydraulic turbines and pumps (BL1)
vi. 6. Identify the minor losses of the fluid flow through pipes (BL-3)

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II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
DC MACHINES AND TRANSFORMERS LAB					

Course Objectives:

The objectives of this course is to acquire knowledge

i. To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
ii. To control the speed of DC motors.
iii. To determine and predetermine the performance of DC machines.
iv. 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. Determination of critical field resistance and critical speed.
2. Brake test on DC shunt motor. Draw the performance characteristics
3. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
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. Determination of losses at rated speed.
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

Course Outcomes:

The Student should be able to

i. Determine and predetermine the performance of DC machines and Transformers.
ii. Control the speed of DC motor.
iii. Obtain three phase to two phase transformation.

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II Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
CONTROL SYSTEMS LAB					

Course Objectives:

The objectives of this course is to acquire knowledge

i. on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors, stepper motor and potentiometer.
ii. time and frequency responses of control system with and without controllers and compensators.
iii. To understand the time and frequency response plots.
iv. To know the stability of the systems up to 5^{th} order using various plots

Any 10 of the following experiments are to be conducted:

1. Time response of Second order system
2. Characteristics of Synchro pair
3. Potentiometer as an error detector
4. Effect of feedback on DC servo motor
5. Effect of P, PD, PI, PID Controller on a second order systems
6. Lag and lead compensation – Magnitude and phase plot
7. Characteristics of DC servo motor
8. Transfer function of DC motor
9. Characteristics of AC servo motor
10. Characteristics of magnetic amplifiers
11. Temperature controller using PID
12. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using MATLAB
13. State space model for classical transfer function using MATLAB.

Course Outcomes

The Student should be able to

i. analyze the performance and working magnetic amplifier, D.C and A.C. servo motors and synchronous motors.
ii. design P, PI, PD and PID controllers
iii. design lag, lead and lag–lead compensators
iv. determine the transfer function of D.C motor
v. control the position of D.C servo motor performance
vi. Able to assess system stability using different plots with the help of simulation

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II Year-II Semester	**SKILL ORIENTED COURSE**				
SIGNALS AND SYSTEMS		**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. representation of elementary signals and their properties
ii. applications of Fourier series analysis.
iii. z-transforms and applications of Fourier Transforms
iv. applications of discrete systems.
v. modulation techniques and application in communication system

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS

Continuous Time signals (CT signals) – Discrete Time signals (DT signals) – Elementary CT signals and DT signals – Classification of CT and DT signals – Basic properties of systems – Classification CT systems and DT systems – Linear time invariant systems and properties.

UNIT II CONTINUOUS TIME SIGNALS AND SYSTEMS

Fourier series analysis: Spectrum of Continuous Time signals – Physical meaning of Fourier series. Fourier Transform in signal analysis – Fourier transforms in system analysis: Differential equation – block diagram representation – convolution integral and impulse response.

UNIT III REPRESENTATION OF DISCRETE TIME SIGNALS

Sampling of Continuous Time signals and aliasing – DTFT and properties – z-transform –Properties of z-transform and physical meaning of DTFT – z transform in Discrete Time signal analysis – DFT basics.

UNIT IV DISCRETE TIME SYSTEMS

Difference equations – Block diagram representation – Convolution sum and impulse response – LTI systems analysis using DTFT and z-transform

UNIT V APPLICATIONS

Applications in communication system: Discrete time sinusoidal amplitude modulation system –

Amplitude modulation with pulse train carrier system – Pulse amplitude modulation

Course Outcomes:

The students should be able to:

i.classify the continuous and discrete time signals and systems.

ii. apply Fourier concepts to analyze the continuous time Systems
iii. apply DTFT and Z transform for the analysis of discrete time signals
iv. determine the discrete time system response using DTFT and Z transform
v. explain the use of discrete time systems in communication applications

Text Books:

i. Allan V. Oppenheim et al, "Signals and Systems", 2nd edition, Prentice Hall of India Pvt. Ltd, 2004

Reference Books:

i. Ashok Ambardar, "Analog and Digital Signal Processing", Thomson Learning Inc., 1999.
ii. Douglas K.Lindner, "Signals and Systems", McGraw-Hill International, 1999.
iii. Simon Haykin and Barry Van Veen, "Signals and Systems", John Willey & Sons, Inc, second edition 2013

Online Resources:

i. www.ee.columbia.edu/~rmcastro/3801/
ii. http://services.eng.uts.edu.au/pmcl/ss/
iii. http://www.tcyonline.com/tests/signals-and-systems-

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER ELECTRONICS					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. characteristics of various power semiconductor devices and analyze the operation of silicon-controlled rectifier.
ii. operation of half-wave and full-wave phase-controlled rectifiers and analyze harmonics in the input current.
iii. operation of three phase full-wave converter and dual converter.
iv. operation of ac voltage controller, single phase cyclo converters and high frequency dc-dc converters.
v. working of inverters and application of pwm techniques for voltage control and harmonic mitigation.

UNIT - I: Power Semi-Conductor Devices

Power transistors- Basic structure and working of power MOSFET and power IGBT. Characteristics of power MOSFET and power IGBT-Silicon controlled rectifiers (SCR's)- Basic theory of operation of SCR-Static & Dynamic characteristics of SCR- Turn on and turn off methods of SCR-Snubber circuit Design.

UNIT - II: **Single Phase - Phase Controlled Rectifiers and Harmonic Analysis**

Half wave converters with R, RL and RLE loads- Derivation of average output voltage and output current- Effect of freewheeling diode for RL load. Fully controlled converters with R, RL and RLE loads-Derivation of output voltage and current - Effect of source Inductance. Semi Converters (Half Controlled) operation with R, RL and RLE loads - Harmonic analysis for input/source current waveform in a system with a large load inductance -Calculation of input power factor.

UNIT-III: Three Phase - Phase Controlled Rectifiers

Three Phase Half wave and Full wave converters with R and RL loads-Semi converter (Half Controlled) with R and RL loads- Derivation of average and rms output voltages-Line commutated Inverter operation-Dual converters with non-circulating and circulating currents.

UNIT - IV: AC-AC and DC-DC Converters

Single phase AC voltage controller with R and RL load- Single phase Bridge type Cyclo converter with R and RL load (Principle of operation) -High frequency DC-DC converters: Buck Converter operation, Time ratio control and current limit control strategies-Voltage and current waveforms-Derivation of output voltage-Boost converter operation-Voltage and current waveforms-Derivation of output voltage - Buck-Boost converter operation -Voltage and current waveforms.

UNIT - V: **DC-AC Inverters**

Single phase half bridge and full bridge inverters - Three phase Inverters (120^0 and 180^0 modes of operation) - PWM techniques- Single Pulse, Multiple Pulse and Sinusoidal PWM, amplitude and frequency modulation Indices -Harmonic analysis.

Course Outcomes:

The students should be able to

i. draw the characteristics of various power semiconductor devices and analyze the operation of silicon-controlled rectifier.
ii. analyze the operation of half-wave and full-wave phase-controlled rectifiers and harmonics in the input current.
iii. explain the operation of three phase full converter and dual converter.
iv. explain the operation of AC voltage controller, single phase cyclo converter and high frequency dc-dc converters.
v. apply PWM technique for voltage control and harmonic mitigation.

Text Books:

i. Power Electronics - by P.S.Bhimbra, Khanna Publishers.
ii. Power Electronics: Circuits, Devices and Applications - by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
iii. Power Electronics: converters, applications &Design –byNedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
iv. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

Reference Books:

i. Power Electronics handbook by Muhammad H. Rashid, Elsevier
ii. Elements of Power Electronics-Philip T.Krein. Oxford.
iii. Thyristorised Power Controllers - by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER					

Course Objectives:

The objective of this course is to acquire knowledge to

i. compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
ii. study the Short and Medium length transmission lines, their models and performance.
iii. study the performance and modeling of long transmission lines.
iv. study the effect of travelling waves on transmission lines and study the factors affecting the performance of transmission lines and power factor improvement methods.
v. 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-Numerical Problems–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–Numerical Problems.

UNIT - II: Performance of Short and Medium Transmission Lines

Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T–Nominal-π and A, B, C, D Constants for symmetrical and Asymmetrical Networks– Numerical Problems–Mathematical Solutions to estimate regulation and efficiency of all types of lines – Numerical Problems.

UNIT - III: Performance of Long Transmission Lines

Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D Constants–Interpretation of the Long Line Equations, regulation and efficiency– Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves – Representation of Long Lines – Equivalent-T and Equivalent πnetwork models-Numerical Problems.

UNIT-IV: Power System Transients &Factors governing the Performance of Transmission line

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. Skin and Proximity effects – Description and effect on Resistance of Solid Conductors –Ferranti effect – Charging Current –Shunt Compensation –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–Numerical Problems – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement–Numerical Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

Course Outcomes:

The students should be able to

i. know various transmission line parameters during different operating conditions.
ii. know the performance of short and medium transmission lines.
iii. analyze the performance of long transmission line.
iv. discuss about corona phenomenon and compute the power loss due to corona.
v. calculate sag of overhead transmission lines and string efficiency of insulators.

Text Books:

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

Reference Books:

i. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition.
ii. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
iii. A Text Book on Power System Engineering by L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, DhanpatRai & Co.Pvt. Ltd.
iv. Power System Analysis, Arthur R. Bergen, Pearson Education.
v. 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**
ELECTROMAGNETIC FIELD THEORY					

Course objectives:
The objective of this course is to acquire knowledge on
i. electric field and potentials due to different configurations of static charges.
ii. properties of conductors and dielectrics, calculate the capacitance of different configurations. Understand the concept of conduction and convection current densities.
iii. magnetic fields produced by currents in different configurations, application of Ampere's law and the Maxwell's second and third equations and to study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops.
iv. concept of self and mutual inductances and the energy stored.
v. time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced EMF

UNIT – I Electrostatics
Electrostatic Fields – 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 – Maxwell's first law, div(D)=ρ_v Laplace's and Poison's equations and solution of Laplace's equation in one variable.

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 behavior in electric field.
Polarization, boundary conditions between conduction to dielectric and dielectric to dielectrics. Capacitance of parallel plates, spherical and coaxial cables with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity

UNIT – III Magneto statics, Ampere's Law and Force in magnetic fields
Static magnetic field – Biot-Savart's law – Oesterd's experiment, 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, field due to a circular loop, point form of Ampere's circuital law, 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 – simple problems, modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

Course outcomes:

The student should be able to

i. determine electric fields and potentials using guass's law or solving laplace's or possion's equations, for various electric charge distributions.
ii. calculate and design capacitance, energy stored in dielectrics.
iii. calculate the magnetic field intensity due to current, the application of ampere's law and the maxwell's second and third equations and determine the magnetic forces and torque produced by currents in magnetic field.
iv. determine self and mutual inductances and the energy stored in the magnetic field.
v. calculate induced emf, understand the concepts of displacement current and poynting vector.

Text Books:

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

Reference Books:

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

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

NON-CONVENTIONAL ENERGY SOURCES

(OPEN ELECTIVE-I)

Course Objectives

The objectives of this course is to acquire knowledge on

i. solar radiation data, extraterrestrial radiation, radiation on earth's surface.
ii. maximum power point techniques in solar pv and wind.
iii. wind energy conversion systems, Betz coefficient, tip speed ratio.
iv. basic principle and working of hydro, tidal systems
v. basic principle and working biomass, fuel cell and geothermal systems.

UNIT–I:

Fundamentals of Energy Systems

Energy conservation principle, Energy scenario (world and India), Solar radiation**:** Outside earth's atmosphere, Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surface, Numerical problems.

UNIT–II:

Solar Thermal Systems

Liquid flat plate collections**:** Performance analysis, Transmissivity, Absorptivity, Product collector efficiency factor, Collector heat removal factor, Numerical problems, Introduction to solar air heaters, Concentrating collectors and solar pond.

UNIT–III:

Solar Photovoltaic Systems

Balance of systems, I-V & P-V characteristics, System design**,** Storage sizing, PV system sizing, Maximum power point techniques**,** Perturb and observe (P&O) technique, Incremental Conductance (INC), Hill climbing technique.

Wind Energy

Wind patterns, Types of turbines, Kinetic energy of wind, Betz coefficient, Tip–speed ratio, efficiency, Power output of wind turbine, Selection of generator (synchronous, induction), Maximum power point tracking.

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, Numerical problems, Wave power-basics, Kinetic energy equation.

UNIT–V:

Biomass, fuel cells and geothermal systems

Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat– Different digesters and sizing, Fuel cell**:** classification – Efficiency – V-I characteristics–Geothermal**:** classification – Dry rock and acquifer – Energy analysis.

Learning Outcomes:

The students should be able to

i. analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface.
ii. develop maximum power point techniques in solar PV and wind.
iii. explain wind energy conversion systems, Betz coefficient , tip speed ratio.
iv. explain basic principle and working of hydro, tidal systems
v. explain the basic principle of biomass ,fuel cell and geothermal systems.

Text Books:

i. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition
ii. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis Electrical and Electronics Engineering 163
iii. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford.

Reference Books:

i. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal,World scientific, Singapore.
ii. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
iii. Renewable energy technologies – A practical guide for beginners –Chetong Singh Solanki, PHI.

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
BASICS OF CONTROL SYSTEMS (OPEN ELECTIVE-I)					

Course objectives:

The objective of this course is to acquire knowledge on

i. mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
ii. time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers and to investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
iii. Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
iv. basic aspects of design and compensation of linear control systems using Bode plots.
v. state models and analyze the systems and also 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, effects of proportional (P), proportional-lintegral (PI),proportional-integral-derivative (PID) systems.

Stability and root locus technique

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 to the transfer function.

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.

Course Outcomes:

The student should be able to

i. derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
ii. determine time response specifications of second order systems and absolute and relative stability of LTI systems using routh's stability criterion and the root locus method.
iii. analyze the stability of LTI systems using frequency response methods.
iv. design lag, lead, lag-lead compensators to improve system performance from bode diagrams.
v. represent physical systems as state models and determine the response. understanding the concepts of controllability and observability.

Text Books:

i. Control Systems principles and design by M.Gopal, Tata McGraw Hill education Pvt Ltd., 4th edition.
ii. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

i. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
ii. Control Systems by ManikDhanesh N, Cengage publications.
iii. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
iv. Control Systems Engineering by S.Palani, Tata McGraw Hill Publications.

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRINCIPLES OF ELECTRIC POWER CONVERSION (OPEN ELECTIVE-I)					

Course Objectives:
The objectives of this course is to acquire knowledge to

i. understand the basics in the electric power conversion using power switching devices
ii. evaluate the conversion with the help of available electrical machines drives
iii. evaluate the conversion for range of renewable energy sources
iv. analyses the different energy storage systems
v. identify the various industrial and domestic applications

UNIT-I: POWER ELECTRONIC DEVICES AND CONVERTERS:

V-I Characteristics of SCR, MOSFET and IGBT. Phase controlled rectifiers, DC-DC converters and Inverters.

UNIT-II: APPLICATIONS TO ELECTRIC DRIVES:

Speed control of DC motor, Induction motors, PMSM and BLDC drives

UNIT-III: APPLICATIONS TO RENEWABLE ENERGY:

Introduction to solar cell, solar panels, MPPT, wind and other renewable energy sources, Integration of renewable energy sources to the grid.

UNIT-IV: ENERGY STORAGE SYSTEMS:

Study of automotive batteries, SMF, pumped storage systems, super-capacitors; fly wheels – applications, Li-ion batteries and applications to electric vehicles.

UNIT-V: DOMESTIC AND INDUSTRIAL APPLICATIONS:

Induction heating, welding, melting, hardening, lighting applications and their control, UPS, battery chargers

Course Outcomes:
The students will able to

i. learn the basic principles of power electronic devices and converters
ii. apply the power electronic converters for electrical machines
iii. apply the power electronic converters for renewable energy sources
iv. learn the different energy storage systems and its applications
v. know the different domestic and industrial applications of power electronic converters

Text Books:

i. M.H.Rashid: Power Electronics-circuits, Devices and applications, Prentice Hall India, New Delhi,2009
ii. P.S.Bhimbra: Power Electronics, Khanna publishers, New Delhi,2012
iii. Ned Mohan, Undeland and Robbin: Power electronics converters, applications and design, John Willey & Sons, Inc. NewYork, 2006.
iv. Utilization of Electrical Energy and Traction, J.B.Gupta, Rajeev Manglik, RohithManglik, KATSON Books

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COMPUTER ORGANIZATION (PROGRAM ELECTIVE-I)					

Course Objectives:

i. Gives a view of computer system from user's perspective, representation of data.
ii. Understand the architecture of a modern computer with its various processing units. Also the Performance measurement of the computer system.
iii. Describes the means of interaction devices with CPU, their characteristics, modes.
iv. Description of different parameters of a memory system, organization and mapping of various types of memories.
v. Illustration of data paths and control flow for sequencing in CPUs, Microprogramming of control unit of CPU.

UNIT -I:

Basic Structure of Computers: Functional unit, Basic Operational concepts, Bus structures, System Software, Performance, The history of computer development.

Data Representation: Data types, Complements, Fixed Point Representation, Floating – Point Representation, Other Binary Codes, Error Detection codes.

UNIT -II:

Machine Instruction and Programs:

Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Addressing Modes, Basic Input/output Operations, The role of Stacks and Queues in computer programming equation. Component of Instructions: Logic Instructions, shift and Rotate Instructions.

UNIT -III:

Type of Instructions: Arithmetic and Logic Instructions, Branch Instructions, Addressing Modes, Input/output Operations.

Input/Output Organization: Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access, Buses: Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI) Bus, Universal Serial Bus (USB).

UNIT -IV:

The Memory Systems: Basic memory circuits, Memory System Consideration, Read-Only Memory: ROM, PROM, EPROM, EEPROM, Flash Memory, Cache Memories: Mapping Functions, INTERLEAVING **Secondary Storage:** Magnetic Hard Disks, Optical Disks.

UNIT -V:

Processing Unit: Fundamental Concepts: Register Transfers, Performing an Arithmetic or Logic Operation, Fetching A Word from Memory, Execution of Complete Instruction, Hardwired Control, **Micro programmed Control:** Microinstructions, Micro program Sequencing, Wide Branch Addressing Microinstructions with next – Address Field.

Course Outcomes:

i. Understand the architecture of modern computer.
ii. Able to calculate the effective address of an operand by addressing modes.
iii. Apply different instruction types.
iv. Determine the importance of memory management system of computer.
v. Design the roles and functions of processing unit and micro programmed control.

Text Books:

i. Computer Organization, Carl Hamacher, Zvonks Vranesic, Safea Zaky, 5th Edition, McGraw Hill.
ii. Computer Architecture and Organization, John P. Hayes, 4th Edition, McGraw Hill.

Reference Books:

i.Computer Organization and Architecture – William Stallings Sixth Edition, Pearson/PHI.
ii.Structured Computer Organization –Andrew S.Tanenbaum, 4th Edition PHI/Pearson.
iii. Fundamentals or Computer Organization and Design, - Sivaraama Dandamudi Springer Int. Edition.
iv."Computer Organization and Design: The Hardware/Software Interface" by David A. Patterson and John L. Hennessy.
vi. J.P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.

E-Resources:

i. https://nptel.ac.in/courses/106/106/106106092/
ii. https://nptel.ac.in/courses/106/105/106105163/

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
RENEWABLE AND DISTRIBUTED ENERGY TECHNOLOGIES (PROGRAM ELECTIVE-I)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. solar radiation data, extraterrestrial radiation, radiation on earth's surface.
ii. maximum power point techniques in solar pv and wind energy.
iii. wind energy conversion systems, Betz coefficient, tip speed ratio.
iv. basic principle and working of biomass, fuel cell and geothermal systems.
v. importance of distributed generation

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UNIT – I: Fundamentals of Energy Systems, Solar Energy and Solar Thermal Systems

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 Liquid flat plate collectors**:** Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants

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.

UNIT - IV: 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

UNIT - V: **Need for distributed generation**

Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

Course Outcomes:

The student should be able to

i. analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
ii. develop maximum power point techniques in solar pv and wind energy systems.
iii. explain wind energy conversion systems, wind generators, power generation.
iv. explain basic principle and working of biomass, fuel cell and geothermal systems.
v. analyze the current scenario in distributed generation and placement of DG source

Text Books:

i. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
ii. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.
iii. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000

Reference Books:

i. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
ii. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
iii. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
iv. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
v. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
vi. Non conventional energy source –B.H.khan- TMH-2nd edition.

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
JAVA PROGRAMMING (PROGRAM ELECTIVE-I)					

Course Objectives:

i. Implementing programs for user interface and application development using core java principles
ii. Focus on object oriented concepts and java program structure and its installation
iii. Comprehension of java programming constructs, control structures in Java Programming Constructs
iv. Implementing Object oriented constructs such as various class hierarchies, interfaces and exception handling
v. Understanding of Thread concepts and I/O in Java
vi. Being able to build dynamic user interfaces using applets and Event handling in java
vii. Understanding of Various Components of Java AWT and Swing and write Code Snippets using them.

UNIT -I:

Introduction to OOP

Introduction, Need of Object Oriented Programming, Principles of Object Oriented Languages, Procedural languages Vs OOP, Applications of OOP, History of JAVA, Java Virtual Machine, Java Features, Program structures, Installation of JDK1.6

UNIT -II:

Variables, Primitive Data types, Identifiers- Naming Conventions, Keywords, Literals, Operators-Binary, Unary and ternary, Expressions, Precedence rules and Associativity, Primitive Type Conversion and Casting, Flow of control-Branching, Conditional, loops.

Classes and Objects- Classes, Objects, Creating Objects, Methods, constructors-Constructor overloading, cleaning up unused objects-Garbage collector, Class variable and Methods-Static keyword, this keyword, Arrays, Command line arguments.

UNIT -III:

Inheritance: Types of Inheritance, Deriving classes using extends keyword, Method overloading, super keyword, final keyword, Abstract class.

Interfaces, Packages and Enumeration: Interface-Extending interface, Interface Vs Abstract classes, Packages-Creating packages, using Packages, Access protection, java.lang package.

Exceptions & Assertions - Introduction, Exception handling techniques-try...catch, throw, throws, finally block, user defined exception, Exception Encapsulation and Enrichment, Assertions.

UNIT -IV:

Multi-Threading: java.lang.Thread, The main Thread, Creation of new threads, Thread priority, Multithreading- Using isAlive() and join(), Synchronization, suspending and Resuming threads, Communication between Threads.

Input/output: Reading and writing data, java.io package
Applet: Applet class, Applet structure, Applet life cycle, sample Applet programs.

UNIT -V:

Event handling: event delegation model, sources of event, Event Listeners, adapter classes, inner classes.
Abstract Window Toolkit : Importance of AWT, Java.awt.package, Components and Containers, Button, Label, Check Box, Radio Buttons ,List Boxes, Choice Boxes, Text Field and Text Area, Container Classes, LayOuts, Menu, Scroll bar.
Swing: Introduction, JFrame, JApplet, JPanel, Components in Swings, Layout Managers, List and JScroll Pane, SplitPane, JTabbedPane, JTree, DialogBox, Pluggable Look and Feel.

Course Outcomes:

i. Understand Java programming concepts and utilize Java Graphical User Interface in Program writing.
ii. Write, compile, execute and troubleshoot Java programming for networking concepts.
iii. Build Java Application for distributed environment.
iv. Design and Develop multi-tier applications.
v. Identify and Analyze Enterprise applications.

Text Books:

i. The Complete Reference Java, 8ed, Herbert Schildt, TMH
ii. Programming in JAVA, Sachin Malhotra, Saurabh Choudhary, Oxford.
iii. JAVA for Beginners, 4e, Joyce Farrell, Ankit R. Bhavsar, Cengage Learning.

Reference Books:

i. JAVA Programming, K.Rajkumar, Pearson
ii. Core JAVA, Black Book, Nageswara Rao, Wiley, Dream Tech
iii. Core JAVA for Beginners, Rashmi Kanta Das, Vikas.
iv. Object Oriented Programming through JAVA , P Radha Krishna , University Press.
v. Object oriented programming with JAVA, Essentials and Applications, Raj Kumar Bhuyya, Selvi, Chu TMH
vi. Introduction to Java Programming, 7th ed, Y Daniel Liang, Pearson

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III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
PULSE AND DIGITAL CIRCUITS (PROGRAM ELECTIVE-I)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. basic terms related to linear wave shaping
ii. operations of diodes as as integrator, differentiator, clippers, clamper circuits.
iii. characteristics of switching devices such as diode, transistor, SCR.
iv. operation of multivibrators and time base generators
v. synchronization and realization of logic gates using diodes and transistors

UNIT I - LINEAR WAVE SHAPING:

High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square and ramp inputs. RC network as differentiator and integrator, attenuators, its applications in CRO probe, RL and RLC circuits and their response for step input, Ringing circuit.

UNIT II - NON-LINEAR WAVE SHAPING:

Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, applications of voltage comparators. Clamping operation, clamping circuit taking Source and Diode resistances into account, Clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage, synchronized clamping.

UNIT III - SWITCHING CHARACTERISTICS OF DEVICES:

Diode as a switch, piecewise linear diode characteristics, Transistor as a switch, Break down voltage consideration of transistor, saturation parameters of Transistor and their variation with temperature, Design of transistor switch, transistor-switching times, Silicon-controlled-switch circuits, Sampling Gates: Basic Operating principles of Sampling Gates, Four Diode Sampling Gate, Unidirectional and Bi-directional Sampling Gates, four Diode Sampling Gate, Reduction of pedestal in Gate Circuits.

UNIT IV - MULTIVIBRATORS:

Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using transistors, TIME BASE GENERATORS: General features of a time base signal, methods of generating time base waveform, Miller and Bootstrap time base generators – basic principles, Transistor miller time base generator, Transistor Bootstrap time base generator, Current time base generators, Methods of linearity and improvement.

UNIT V - SYNCHRONIZATION AND FREQUENCY DIVISION:

Pulse of Synchronization of relaxation devices, stability of relaxation devices, Frequency division in sweep circuit, Astable relaxation circuits, Monostable relaxation circuits, Synchronization of a sweep circuit with

symmetrical signals, Sine wave frequency division with a sweep circuit, A sinusoidal divider using regeneration and modulation.

REALIZATION OF LOGIC GATES USING DIODES & TRANSISTORS:

AND, OR and NOT gates using Diodes and transistors, DCTL, RTL, DTL, TTL and CML logic families and its comparison.

Course Outcomes:

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

i. learn the concepts and applications of RC and RLC circuits.
ii. understand the applications of diode as integrator, differentiator, clippers, clampler circuits.
iii. learn various switching devices such as diode, transistor, SCR.
iv. design mutivibrators for various applications, synchronization techniques and sweep circuits.
v. realizing logic gates using diodes and transistors**.**

Text Books:

i. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, McGraw-Hill, 1991.
ii. Solid State Pulse circuits - David A. Bell, PHI, 4th Edn., 2002

References Books:

i. Pulse and Digital Circuits – A. Anand Kumar, PHI, 2005.
ii. Fundamentals of pulse and digital circuits-Ronald.J. Tocci,3 ed. ,2008
iii. Pulse and Digital Circuits-Motheki S.Prakash rao,2006,TMH
iv. Wave Generation and Shaping - L. Strauss.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
LINEAR IC APPLICATIONS (PROFESSIONAL ELECTIVE-I)					

Course Objectives:

i. To understand the basic operation &performance parameters of differential amplifiers.
ii. To understand & learn the measuring techniques of performance parameters of OP-AMP
iii. To learn the linear and non-linear applications of operational amplifiers and the analysis & design of different types of active filters using opamps
iv. To learn the internal structure, operation and applications of different analog ICs
v. To Acquire skills required for designing and testing integrated circuits

UNIT I: INTEGRATED CIRCUITS:
Differential Amplifier- DC and AC analysis of Dual input Balanced output Configuration, Properties of other differential amplifier configuration (Dual Input Unbalanced Output, Single Ended Input – Balanced/ Unbalanced Output), DC Coupling and Cascade Differential Amplifier Stages, Level translator.

UNIT II: 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 III: 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.
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).

Course Ooutcomes:

i. Design circuits using operational amplifiers for various applications.
ii. Analyze and design amplifiers and active filters using Op-amp.
iii. Diagnose and trouble-shoot linear electronic circuits.
iv. Understand the gain-bandwidth concept and frequency response of the amplifier configurations.
v. Understand thoroughly the operational amplifiers with linear integrated circuits.

TEXT BOOKS:

i. Linear Integrated Circuits – D. Roy Choudhury, New Age International (p) Ltd, 2nd Edition,2003.
ii. Op-Amps & Linear ICs - Ramakanth A. Gayakwad, PHI,1987.

REFERENCES:

i. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons;2nd Edition,2010
ii. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.
iii. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd.
iv. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition.
v. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition
vi. Operational Amplifiers–C.G. Clayton, Butterworth & Company Publ. Ltd./Elsevier, 1971

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
INDUCTION AND SYNCHRONOUS LAB					

Course Objectives:
The objectives of this course is to acquire knowledge

i. on speed control of three phase induction motors.
ii. to determine /predetermine the performance three phase and single-phase induction motors.
iii. to improve the power factor of single-phase induction motor.
iv. to predetermine the regulation of three–phase alternator by various methods, find X_d/X_q ratio of alternator and assess the performance of three–phase synchronous motor.

Any 10 experiments of the following are required to be conducted as compulsory experiments:

1. Brake test on three phase Induction Motor
2. Equivalent circuit diagram of three phase Induction motor
3. circle diagram of three phase induction motor
4. Regulation of a three –phase alternator by synchronous impedance method
5. Regulation of a three –phase alternator by m.m.f method
6. Regulation of three–phase alternator by Potier triangle method
7. V and Inverted V curves of a three—phase synchronous motor.
8. Determination of X_d and X_q of a salient pole synchronous machine
9. Equivalent circuit of single-phase induction motor
10. Speed control of induction motor by V/f method.
11. Determination of efficiency of three phase alternator by loading with three phase induction motor.
12. Power factor improvement of single-phase induction motor by using capacitors and load test on single phase induction motor.
13. Heat run test on three phase transformers.

Course Outcomes:
The students should be able to

i. assess the performance of single phase and three phase induction motors.
ii. control the speed of three phase induction motor.
iii. predetermine the regulation of three–phase alternator by various methods.
iv. find the X_d/X_q ratio of alternator and asses the performance of three–phase synchronous motor.

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III Year - I Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
ELECTRICAL SIMULATION LAB					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. analysis and characteristics on semiconductor devices and measurements
ii. analysis of stability criteria on time domain and frequency response analysis.
iii. design and performance analysis of machines and transformers
iv. application on power electronic components and performance analysis

Any 10 experiments of the following are required to be conducted as compulsory experiments:

1. Design & analysis of Series and Parallel resonance circuits.
2. Characteristics of PNP & NPN Transistors.
3. Design of Low Pass and High Pass filters
4. Measurement of active Power of three phase circuit for balanced and unbalanced load.
5. Design & Analysis of Two port network.
6. Obtain frequency response of a given system by using various methods:
(a) General method of finding the frequency domain specifications.
(b) Polar plot
(c) Bode plot
Also obtain the Gain margin and Phase margin.
7. Determine stability of a given dynamical system using following methods.
a) Root locus
b) Bode plot
c) Nyquist plot
8. Design a compensator for a given systems for required specifications.
9. Design & analysis of single phase two winding Transformer.
10.Simulation of three phase Induction Motor.
11. Simulation of Single-phase diode bridge rectifiers with filter for R & RL load
12. Simulation of Three phase diode bridge rectifiers with R, RL load
13. Simulation of Single-Phase full converter using RLE loads
14. Single phase AC Voltage Controller using RL loads.
15. Simulation of Buck & Boost converters.

Course Outcomes:
The students should be able to

i. assess the performance of semi-conductor devices
ii. analyze the stability criteria analysis of time and frequency domain specifications
iii. asses the performance and characteristics of machines and transformers.
iv. simulate the applications of power electronic components of various loads

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III Year-I Semester	**SKILL ORIENTED COURSE**				
ADVANCED COMMUNICATION SKILLS LAB -II		**L**	**T**	**P**	**C**
		1	**0**	**2**	**2**

Course Objectives:

The objectives of this course are:
i. To enable the students develop advanced communication skills in English for academic and social purposes.
ii. To make the students to understand the significance of group discussion and various modalities of a group discussion.
iii. To make the students to excel in opinion giving and argue confidently and logically during Debates.
iv. To expose the students to the nuances involved in oral presentation skills and Public Speaking skills.
v. To train the students in job interviews by exposing them to the prerequisites, types, FAQ's and various preparatory techniques in job interviews.

UNIT - I: JAM: Do's and Don'ts of JAM, speaking practice with various topics

UNIT - II: Group Discussion: Importance, modalities, types, do's and don'ts of a GD

UNIT - III: Debate: Importance of a Debate, General rules for participation in debate, Useful phrases, Sample debates-Activities

UNIT - IV: Oral Presentation & public Speaking:
- Make Effective presentations using posters, Flash cards and PPTs
- Tips for making a presentation
- Do's and Don'ts of a presentation
- Dealing with nerves
- Simulated topics/situations for public speaking

UNIT - V: Interview Skills:
- Significance of job interviews
- Understanding preparatory techniques for job interviews
- Know and answer frequently asked questions (FAQs) at job interviews
- Mock interviews

Course Outcomes:

The students should be able to:

i. improve their speaking ability by using context -specific vocabulary.
ii. Learn how to communicate in a group discussion confidently and fluently by using appropriate expressions.

iii. Expose the learners to various speaking activities and enable them to argue logically and develop critical thinking skills.

iv. Apply various techniques for making effective oral presentation skills and improve public speaking skills.

v. acquire employability skills by integrating communication skills and to excel in job interviews

Reference Books:

1. Effective Technical Communication | 2nd Edition Paperback – 27 July 2017. by M. Ashraf Rizvi (Author).
2. Sanjay Kumar and Pushp Lata. ―Communications Skills‖. Oxford University. Press. 2011.
3. Video /you tube links:
   Muniba Mazari, Malala Yousuf Zahi, Abdul Kalam, Steve Jobs, Mark Zuckerberg…

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - I Semester		**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
INDIAN CONSTITIUTION (MC)					

Course Objectives:

i. To Enable the student to understand the importance of constitution
ii. To understand the structure of executive, legislature and judiciary
iii. To understand philosophy of fundamental rights and duties
iv. To understand the autonomous nature of constitutional bodies like Supreme Court and high court controller and auditor general of India and election commission of India.
v. To understand the central and state relation financial and administrative.

UNIT-I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions;

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT-IV

A.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation Pachayati Raj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women.

Course Outcomes:

At the end of the semester/course, the student will be able to have a clear knowledge on the following:

i. Understand historical background of the constitution making and its importance for building a democratic India.
ii. Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
iii. Understand the value of the fundamental rights and duties for becoming good citizen of India.
iv. Analyze the decentralization of power between central, state and local self-government.
v. Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
    1. Know the sources, features and principles of Indian Constitution.
    2. Learn about Union Government, State government and its administration.
    3. Get acquainted with Local administration and Pachayati Raj.

4. Be aware of basic concepts and developments of Human Rights.
5. Gain knowledge on roles and functioning of Election Commission

References:

i. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
ii. SubashKashyap, Indian Constitution, National Book Trust
iii. J.A. Siwach, Dynamics of Indian Government & Politics
iv. D.C. Gupta, Indian Government and Politics
v. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
vi. J.C. Johari, Indian Government andPolitics Hans
vii. J. Raj IndianGovernment and Politics
viii. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
ix. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-resources:

i. nptel.ac.in/courses/109104074/8
ii. nptel.ac.in/courses/109104045/
iii. nptel.ac.in/courses/101104065/
iv. www.hss.iitb.ac.in/en/lecture-details

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MICROPROCESSORS AND MICROCONTROLLERS					

COURSE OBJECTIVES:

i. To understand learn concepts of microprocessor, different addressing modes and programming of 8086.
ii. Understand interfacing of 8086, with memory and other peripherals.
iii. To learn concepts of PPI, DMA and programmable interrupt controller.
iv. Study the features of advanced processors, Pentium processors.
v. Study the features of 8051 Microcontroller, its instruction set and also other controllers like PIC controllers.

UNIT-I:

8086 ARCHITECTURE: Main features, pin diagram/description, 8086 microprocessor family, 8086 internal architecture, bus interfacing unit, execution unit, interrupts and interrupt responses, 8086 system timing, minimum mode and maximum mode configuration.

8086 PROGRAMMING: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.

UNIT-II:

8086 INTERFACING : Semiconductor memories interfacing (RAM,ROM), 8254 software programmable timer/counter, Intel 8259 programmable interrupt controller, software and hardware interrupt applications, Intel 8237a DMA controller, Intel 8255 programmable peripheral interface, keyboard interfacing, alphanumeric displays (LED,7-segment display, multiplexed 7-segment display, LCD), Intel 8279 programmable keyboard/display controller, stepper motor, A/D and D/A converters.

UNIT-III:

80386 and 80486 MICROPROCESSORS: Introduction, programming concepts, special purpose registers, memory organization, moving to protected mode, virtual mode, memory paging mechanism, architectural differences between 80386 and 80486 microprocessors. Introduction to Pentium and ARM Processors.

UNIT-IV:

Intel 8051 MICROCONTROLLER: Architecture, hardware concepts, input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts.

Assembly language programming: Instructions, addressing modes, simple programs. Interfacing: keyboard, displays (LED, 7-segment display unit), A/D and D/A converters.

UNIT-V:

PIC MICROCONTROLLER: Introduction, characteristics of PIC microcontroller, PIC microcontroller families, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.

COURSE OUTCOMES:

On successful completion of the course module students will be able to

i. Develop the assembly language programs for different addressing modes.
ii. Perform 8086 interfacing with different peripherals and implement programs.
iii. Describe the key features serial and parallel communication.
iv. Design Microcontroller for simple Applications.
v. Distinguish between architectures of various processors and controllers.

TEXT BOOKS:

i. Microprocessors and Interfacing – Programming and Hard ware by Douglas V Hall, SSSP Rao, Tata McGrawHill Education Private Limited, 3rd Edition.
ii. The 8051 Microcontroller & Embedded Systems Using Assembly and C by Kenneth J.Ayala, Dhananjay V.Gadre, Cengage Learninbg , India Edition.

REFERENCES:

i. The Intel Microprocessors-Architecture, Programming, and Interfacing by Barry B.Brey, Pearson, Eighth Edition-2012.
ii. Microprocessors and Microcontrollers-Architecture, Programming and System Design by Krishna Kant, PHI Learning Private Limited, Second Edition, 2014.

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER SYSTEMS ANALYSIS					

Course Objectives:
The objectives of this course is to acquire knowledge ON

i. formulation of Y–bus matrix
ii. power system load flow studies.
iii. Z–Bus building algorithm and also to perform short circuit calculation for symmetrical faults.
iv. unsymmetrical faults and their effects on power system.
v. power system stability and methods to improve it.

UNIT –I:
Per Unit Representation & Topology
Per Unit Quantities–Single line diagram– Impedance diagram of a power system–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.
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 formulation
Formation of Z–Bus**:** Partial network– Algorithm for the Modification of Z_{bus}**:** Addition of element from a new bus to reference– Addition of element from a new bus to an old bus– Addition of element between an old bus to reference and Addition of element between two old buses. – Modification of Z–Bus for the changes in network (Problems).

Symmetrical Fault Analysis
Transients on a Transmission line-Short circuit of synchronous machine (on no-load) - 3–Phase short circuit currents and reactance's of synchronous machine–Short circuit MVA calculations -Series reactors – selection of reactors.
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.

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.

`Course Outcomes:

The students should be able to

i. draw the impedance diagram for a power system network and compute per unit quantities.
ii. find the load flow solution of a power system using different methods.
iii. form z–bus in order to calculate fault current for all types of faults to design protective devices.
iv. find the sequence components of currents for unbalanced power system network.
v. analyze the steady state, transient and dynamic stability concepts of a power system.

Text Books:

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

Reference Books:

i. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
ii. Power System Analysis by Hadi Saadat – TMH Edition.
iii. Power System Analysis by B.R.Gupta, Wheeler Publications.
iv. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – Cengage Learning publications.

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER SYSTEM PROTECTION					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. basic principles and operation of various circuit breakers.
ii. working of different electromagnetic and static relays.
iii. protective schemes for generator and transformers.
iv. protective schemes used for feeders and bus bars.
v. principles of different protective schemes for insulation co–ordination.

UNIT - I:
Switchgear:
Circuit breaker – basic principle of operation – arc phenomenon – initiation and maintenance of arc – arc interruption methods – arc voltage and current waveform in AC circuit breaking – re-striking and recovery voltage – current chopping – DC breakers – rating of circuit breakers – breaking capacity – making capacity – short time rating – working principle and important features of oil CB, minimum oil CB, air blast CB, vacuum CB and SF6 CB – auto high speed re-closing.

UNIT - II:
Protective relaying:
Main and back up protection – basic requirements of protective relaying – classification of relays – induction type – principle – inverse time characteristics – directional over-current and power relays – distance relays – definite distance and distance time relays – differential relays – negative phase sequence relay – static relays – basic static relay – block diagram of static over-current, static directional, static distance and static differential relays.

UNIT - III:
Generator Protection: External and internal faults – differential protection – biased circulating current protection – self balance system – over-current and earth fault protection – protection against failure of excitation.

Transformer protection: Differential protection – self-balance system of protection – over-current and earth fault protection – Buchholz's relay and its operation.

UNIT - IV:
Feeder protection: Protection of radial feeders – protection of parallel feeders – protection of ring mains – differential pilot protection for feeders – Merz Price voltage balance system – translay system.

Transmission Line Protection: Definite distance and time distance protection – phase and earth fault protection – carrier current protection

UNIT - V:
Protection against over voltage and grounding

Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lighting arresters– Insulation coordination– BIL– impulse ratio– Standard impulse test wave– volt-time characteristics– Grounded and ungrounded neutral systems–Effects of ungrounded neutral on system performance– Methods of neutral grounding**:** Solid–resistance–Reactance–Arcing grounds and grounding Practices.

Course Outcomes:

The students should be able to

i. know the principles of arc interruption for application to high voltage circuit breakers of air, oil, vacuum, SF_6 gas type
ii. explicit the working and operation of different types of electromagnetic and static relays.
iii. detect faults and protective schemes for high power generator and transformers.
iv. assess protective schemes for feeders and transmission lines.
v. analyse different types of over voltages and protective schemes required for insulation co–ordination

Text Books:

i. Power System Protection and Switchgear by Badari Ram and D.N Viswakarma, TMH Publications
ii. Power system protection- Static Relays with microprocessor applications.by T.S.Madhava Rao, TMH

Reference Books:

i. Fundamentals of Power System Protection by Paithankar and S.R.Bhide.,PHI, 2003.
ii. Art & Science of Protective Relaying – by C R Mason, Wiley Eastern Ltd.
iii. Protection and Switch Gear by BhaveshBhalja, R.P. Maheshwari, NileshG.Chothani, Oxford University Press, 2013

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

ELECTRIC DRIVES

(PROFESSIONAL ELECTIVE-II)

Course Objectives:
The objectives of this course is to acquire knowledge on

i. fundamentals of electric drive and different electric braking methods.
ii. operation of single-phase controlled converter dc motors and four quadrant operation of dc motors using dual converters.
iii. choppers for speed control of dc motors.
iv. concept of speed control of induction motor drive with variable voltage and v/f control.
v. 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
Single phase half and fully controlled converter fed separately and self-excited DC motor drive – three phase fully controlled converter fed separately 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).

UNIT - IV:
Control of Induction Motor Drives
Stator side control: 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).

Rotor side control: Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.

UNIT - V:
Control of Synchronous Motor Drives

Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (qualitative treatment only).–Variable frequency control–Pulse width modulation.

Course Outcomes:

The students should be able to

i. know about the fundamentals of electric drive and different electric braking methods.
ii. operation of single-phase controlled converter fed dc motors and four quadrant operations of dc motors using dual converters.
iii. apply the knowledge of choppers for speed control of DC Motors.
iv. know the analysis of speed control of induction motor with variable voltage and v/f control.
v. know the analysis of speed control mechanism of synchronous motors

Text Books:

i. Fundamentals of Electric Drives – by G K Dubey Narosa Publications
ii. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley-India Edition

Reference Books:

i. Electric Motors and Drives Fundamentals, Types and Applications, by Austin Hughes and Bill Drury, Newnes.
ii. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications.
iii. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI
iv. Power Electronics handbook by Muhammad H.Rashid, Elsevier.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
DATA BASE MANAGEMENT SYSTEMS (PROGRAM ELECTIVE-II)					

Course Objectives:

i. Train in the fundamental concepts of database management systems, database modeling and design, SQL, PL/SQL, and System implementation techniques.
ii. Enable students to model ER diagram for any customized applications
iii. Provide knowledge on concurrency techniques
iv. Understand normalization theory and apply such knowledge to the normalization of a database.
v. To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

UNIT-I:

An Overview of Database Management: Introduction- Importance of Database System, 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.

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 and3 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.

Course Outcomes:

i. Understand File System Vs Databases.
ii. Understand the usage of Key Constraints on Database.
iii. Create, maintain and manipulate a relational database using SQL
iv. Describe ER model and normalization for database design.
v. Understand efficient data storage and retrieval mechanism, recovery techniques

Text Books:

i. Introduction to Database Systems, CJ Date, Pearson
ii. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition

References Books:

i. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
ii. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
iii. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom Pearson
iv. Data base System Concepts,5/e, Silberschatz, Korth, TMH

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UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
CYBER SECURITY (PROGRAM ELECTIVE-II)					

Course Objective:
The objective of this course is to introduce information security concepts to undergraduate engineering students, so they can defend their personal and organizational information from probable security attacks and incidents.

UNIT-I:
Introduction to Security: Challenges of Securing Information, Definition of Information Security, Attackers, Attacks and Defenses.
Systems Threats and Risks: Software-Based Attacks, Hardware-Based Attacks, Attacks on Virtualized Systems, Hardening the Operating System, Preventing Attacks that Target the Web Browser, Hardening Web Servers, Protecting Systems from Communications-Based Attacks, Applying Software Security Applications.

UNIT-II:
Network Vulnerabilities and Attacks: Network Vulnerabilities, Categories of Attacks, Methods of Network Attacks.
Network Defences: Crafting a Secure Network, Applying Network Security Devices, Host and Network Intrusion Prevention Systems (HIPS/NIPS), Protocol Analyzers, Internet Content Filters, Integrated Network Security Hardware.
UNIT-III:
Access Control: Access Control Models and Practices, Logical Access Control Methods, Physical Access Control.
Authentication: Definition of Authentication, Authentication Credentials, Extended Authentication Protocols, Remote Authentication and Security.

UNIT-IV:
Vulnerability Assessment: Risk Management, Assessment, and Mitigation, Identifying Vulnerabilities.
Security Audit: Privilege Auditing, Usage Auditing, Monitoring Methodologies and Tools.

UNIT-V:
Cryptography: Introduction to Cryptography, Cryptographic Algorithms, Using Cryptography on Files and Disks, Digital Certificates, Public Key Infrastructure, Key Management.

Course Outcomes
Upon completion of the course, it is expected that student will be able to:
i. Understand the basics and need for information security
ii.Identify, analyze, and evaluate infrastructure and network vulnerabilities.
iii.Understand and analyze different access control and authentication methods.
iv.Identify and assess current and anticipated security risks and vulnerabilities with vulnerability assessment

and auditing methods.

v.Learn the fundamentals of cryptography and how cryptography serves as the central language of information security..

Text Book:

i.Security+ Guide to Network Security Fundamentals, Third Edition, Mark Ciampa, Cengage Learning.

Reference Books:

i. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord, Cengage Learning.
ii. Information Security: The Complete Reference, Rhodes-Ousley, Mark, Second Edition, McGraw-Hill.
iii. Information Security: Principles and Practices, Mark S. Merkow, Jim Breithaupt, 2nd Edition, Pearson Education.

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
CLOUD COMPUTING (PROFESSIONAL ELECTIVE-II)					

Course Objective:
Cloud Computing is a large scale distributed computing paradigm which has become a driving force for information technology over the past several years. This course introduce cloud computing technology to undergraduate engineering students, so they can learn, apply and use this technology in their future careers.

UNIT-I:
Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

UNIT-II:
Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud Computing, Cloud Computing is a Service, Cloud Computing is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models

UNIT-III:
Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure, Managing the Cloud Application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:
Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platformas a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNIT-V:
Cloud Providers and Applications: EMC, EMC IT, Captiva Cloud Toolkit, Google Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service,
Amazon Simple Queue service, Microsoft, Windows Azure, Microsoft Assessment and Planning Toolkit, SharePoint, IBM, Cloud Models, IBM Smart Cloud, SAP Labs, SAP
HANA Cloud Platform, Virtualization Services Provided by SAP, Sales force, Sales Cloud, Service Cloud: Knowledge as a Service, Rackspace, VMware, Manjra soft, Aneka Platform**.**

Course Outcomes:

Upon completion of the course, it is expected that student will be able to:

i. Understand and analyze different computing paradigms
ii. Understand the basics of cloud computing and different cloud deployment models.
iii. Understand different cloud implementation and management strategies.
iv. Understand and evaluate different cloud service models.
v. Identify, analyze and use different cloud services/applications/tools available from key cloud providers.

Text Book:

i. Essentials of Cloud Computing, K. Chandrasekhran, CRC press.

Reference Books:

i. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley.
ii. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier.
iii. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly.

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
OPERATING SYSTEMS (PROFESSIONAL ELECTIVE-II)					

Course Objectives:

i. Provide knowledge about the services rendered by operating systems.
ii. Present detail discussion on processes, threads and scheduling algorithms.
iii. Expose the student with different techniques of process synchronization and handling deadlocks.
iv. Discuss various file-system implementation issues and memory management techniques.
v. Learn mass storage management.

UNIT-I: **Operating Systems Overview:**
Introduction: what is an operating system, Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types, Operating System Generation.

UNIT–II: Process Management:
Process concept: Process Concept, Process Scheduling, Operations on Processes, Inter process Communication.
Multithreaded Programming: Overview, Multithreading models, Threading Issues.
Process scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-III: Synchronization:
Process Synchronization: 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 from Deadlock.

UNIT-IV: Memory Management:
Memory Management strategies: Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.
Virtual Memory Management: Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT-V: File system Interface- The concept of a file, Access Methods, Directory and Disk structure, File system mounting.
File System implementation: File system structure, allocation methods, free-space management.
Mass-storage structure: Overview of Mass-storage structure, Disk scheduling, Device drivers.

Course Outcomes:

i. Understand the importance of operating systems and different types of system calls.
ii. Analyze the communication between processes and various process scheduling algorithms.
iii. Understand the process synchronization, different ways for deadlocks handling.
iv. Analyze various memory mapping techniques and different page replacement methods.
v. Evaluate various file allocation and disk scheduling algorithms.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley, 2013.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education, 2008. (for Interprocess Communication and File systems).

References:

i. Tanenbaum A S, Woodhull A S, Operating Systems Design and Implementation, 3rd edition, PHI, 2006.
ii. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGraw-Hill, 2012.
iii. Stallings W, Operating Systems -Internals and Design Principles, 6th edition, Pearson Education, 2009.
iv. Nutt G, Operating Systems, 3rd edition, Pearson Education, 2004.

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III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS

(OPEN ELECTIVE-II)

Course Objectives:

The objectives of this course is to acquire knowledge to

i. have knowledge on PLC.
ii. acquire the knowledge on programming of PLC.
iii. understand different PLC registers and their description.
iv. have knowledge on data handling functions of PLC.
v. know how to handle analog signal and converting of A/D in PLC.

Unit I:
Introduction
PLC Basics: PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

Unit II:
PLC Programming
PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Digital logic gates, programming in the Boolean algebra system, conversion examples. Ladder diagrams and sequence listings, ladder diagram construction.

Unit III:
Programmable Timers and Counters
Timer instructions – On delay time instruction – Off delay timer instruction – Retentive timer – Counter instructions – Up counter – Down counter – Cascading counters – Incremental encoder – Counter applications – Combining counter and timer functions.

Unit IV:
Program Control Instructions
Master control reset instruction – Jump instructions and sub routines – Immediate input and output instructions.- Data manipulation – Data transfer operation – Data compare instruction – Data manipulation programs – Numerical data I/O interfaces – Math instructions – Addition, subtraction, multiplication & division instruction – Sequential instructions – Sequence programs – Shift registers – Word shift registers.

Unit V:
Applications
Control of water level indicator – Alarm monitor - Conveyor motor control – Parking garage – Ladder diagram for process control – PID controller.

Course Outcomes:
The students are able to:

i. know the PLCs and their I/O modules.
ii. develop control algorithms to PLC using ladder logic.
iii. manage PLC registers for effective utilization in different applications.
iv. design PID controller with PLC.
v. handle analog signal and converting of A/D in PLC

Text Books:

i. Programmable logic controllers by Frank D.Petruzella- McGraw Hill – 3rd Edition.
ii. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI

Reference Books:

i. Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
ii. Introduction to Programmable Logic Controllers- Gary Dunning-CengageLearning. Programmable Logic Controllers –W.Bolton-Elsevier publisher

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

ENERGY STORAGE SYSTEMS

(OPEN ELECTIVE-II)

Course Objectives:

The objectives of this course is to acquire knowledge on

i. need of energy storage and different types of energy storage.
ii. thermal, magnetic, electrical and electrochemical energy storage systems.
iii. emerging needs for EES pertaining to Renewable energy
iv. types of electrical energy storage systems
v. design and Applications of Electrical Energy Storage

UNIT - I: Introduction:
Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT - II: Energy Storage Systems:
Thermal Energy storage-sensible and latent heat, phase change materials, Energy and exergy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, thermodynamics of fuel cells, Types of fuel cells, Fuel cell performance, Electrochemical Energy Storage- Battery, primary, secondary and flow batteries.

UNIT - III Needs for Electrical Energy Storage:
Emerging needs for EES, More renewable energy-less fossil fuel, Smart Grid uses - the roles of electrical energy storage technologies-the roles from the viewpoint of a utility-the roles from the viewpoint of consumers-the roles from the viewpoint of generators of renewable energy.

UNIT - IV: Types of Electrical Energy Storage systems:
Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), super charging stations, Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT - V: Design and Applications of Electrical Energy Storage:

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

Course Outcomes:

The students should be able to

i. know the characteristics of electricity and need for continuous and flexible supply
ii. discuss about the role of electrical energy storage technologies
iii. analyse features of EES systems
iv. acquire knowledge on various types of EES systems
v. apply EES systems to various applications such as smart micro grid, smart home etc.

Text Books:

i. Energy Storage - Technologies and Applications by Ahmed FaheemZobaa, InTech.
ii. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
iii. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

Reference Books:

i. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.
ii. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.
iii. Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V.
iv. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.

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III Year – II Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
SOFT COMPUTING TECHNIQUES (OPEN ELECTIVE-II)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. principle of soft computing with its usage in various applications

ii. implementation of Artificial Neural systems concepts, technologies, and applications

iii. learning basic concepts & convergence of GA

iv. learning basic concepts of fuzzy systems

v. analyses different evolutionary algorithms and its applications

Unit I:Introduction to AI

Artificial Intelligence – a Brief Review – Pitfalls of Traditional AI – Need for Computational Intelligence – Importance of Tolerance of Imprecision and Uncertainty - Constituent Techniques – Overview of Artificial Neural Networks - Fuzzy Logic - Evolutionary Computation.

Unit II: Artificial Neural Networks

Supervised Learning: Introduction and how brain works, Neuron as a simple computing element, The perceptron, Backpropagation networks: architecture, multilayer perceptron, backpropagation learning-input layer, accelerated learning in multilayer perceptron, The Hopfield network, Bidirectional associative memories (BAM), RBF Neural Network.

Unsupervised Learning: Hebbian Learning, Generalized Hebbian learning algorithm, Competitive learning, Self- Organizing Computational Maps: KohonenNetwork.

Unit III: Genetic algorithms

Genetic algorithms basic concepts, encoding, fitness function, reproduction-Roulette wheel, Boltzmann, tournament, rank, and steady state selections, Convergence of GA, Applications of GA-case studies.

Unit IV: Fuzzy Logic

Fuzzy Sets – Properties – Membership Functions - Fuzzy Operations. Fuzzy Logic and Fuzzy Inference System

Unit V: Evolutionary Computation

Evolutionary Computation - Overview of other Bio-inspired Algorithms - Swarm Intelligence Algorithms

Course Outcomes:

The students should be able to

i. develop application on different soft computing techniques like fuzzy, GA and neural network

ii. implement artificial neural system.

iii. familiar with the basic concepts & convergence of GA

iv. discuss about the basic concepts of fuzzy systems and its applications

v. apply different evolutionary algorithms to various applications

Textbooks:

i. R. Rajasekaran and G. A and Vijayalakshmi Pai, Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications, Prentice Hall of India

ii. D. E. Goldberg, Genetic Algorithms in Search, Optimization, and Machine Learning, Addison-Wesley

iii. T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill

Reference books

1. L. Fausett, Fundamentals of Neural Networks, Prentice Hall

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
POWER ELECTRONICS LABORATORY					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. characteristics of various power electronic devices.
ii. performance of single-phase half controlled and fully controlled bridge converters with both resistive and inductive loads.
iii. operation of three phase half controlled and fully controlled bridge converters with both resistive and inductive loads.
iv. working of single phase and three phase inverters.
v. performance of AC Voltage controller and DC-DC Converters.

List of experiments

Any 10 of the Following Experiments are to be conducted

1. Study of Characteristics of Thyristor, MOSFET & IGBT.
2. Design and development of a firing circuit for Thyristor.
3. Design and development of gate drive circuits for IGBT.
4. Single Phase half wave-controlled converter with R and RL load.
5. Single Phase half-controlled converter with R and RL load.
6. Single Phase fully controlled bridge converter with R and RL load.
7. Three Phase half-controlled converter with R and RL load.
8. Three Phase fully controlled converter with R and RL load.
9. Single Phase AC Voltage controller with R and RL Load.
10. single phase half bridge and full bridge inverter with R and RL load.
11. Three Phase inverter with R-load (120^0 and 180^0 modes).
12. Buck and Boost converter in CCM operation.
13. Simulation of single-phase full converter with R and RL Load using MAT LAB/P-spice /PSIM.
14. Simulation of three phase full converter with R and RL Load using MAT LAB/P-spice /PSIM.
15. Simulation of Buck-Boost converter in CCM operation using MAT LAB/P-spice /PSIM.

Course Outcomes:

The students should be able to:

i. draw the characteristics of various power electronic devices.
ii. analyze the performance of single phase and three phase half and full bridge converters with both resistive and inductive loads.
iii. understand the working of Buck converter, Boost converter, single–phase and three phase inverters.
iv. understand the operation of single-phase AC voltage regulator with resistive and inductive loads.
v. Simulate various power electronic converters.

Text Books:

i. Simulation of Power Electronic Circuit, by M.B.patil, V.Ramanarayan, V.T.Ranganathan.Narosha,2009.
ii. P-spice for circuits and electronics using PSPICE – by M.H.Rashid, M/s PHI Publications
iii. Power Electronics: Circuits, Devices and Applications - by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998

Reference Books:

i. P-spice A/D user`s manual – Microsim, USA
ii. P-spice reference guide – Microsim, USA
iii. MATLAB user`s manual – Mathworks, USA
iv. SIMULINK user`s manual – Mathworks, USA

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester		**L**	**T**	**P**	**C**
		0	**0**	**3**	**1.5**
POWER SYSTEMS LABORATORY					

Course Objectives:
The objectives of this course is to acquire knowledge to

i. determination of the parameters of various power system components
ii. determination of parameters of transmission line
iii. execution of load flow analysis

List of experiments

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. Power Angle Characteristics of 3phase Alternator with infinite bus bars.
6. Dielectric strength of Transformer oil.
7. Calibration of Tong Tester.
8. Load flow studies using Gauss-seidel method
9. Load flow studies using Fast De-coupled method
10. Load flow studies using N-R method.

Course Outcomes:
The students should be able to

i. evaluate the parameters of various power system components
ii. determine parameters of transmission line
iii. examine load flow in a power system network

Text Books:

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

Reference Books:

i. Power System Analysis – by A.R.Bergen, Prentice Hall, Inc.
ii. Power System Analysis by HadiSaadat – TMH Edition.
iii. Power System Analysis by B.R.Gupta, Wheeler Publications.
iv. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – Cengage Learning publications

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
III Year - II Semester		**0**	**0**	**3**	**1.5**
MICROPROCESSORS AND MICROCONTROLLERS LABORATORY					

LIST OF EXPERIMENTS

PART- A: (Minimum of 5 Experiments has to be performed)

8086 Assembly Language Programming using Assembler Directives

1. Sorting.
2. Multibyte addition/subtraction
3. Sum of squares/cubes of a given n-numbers
4. Addition of n-BCD numbers
5. Factorial of given n-numbers
6. Multiplication and Division operations
7. Stack operations
8. BCD to Seven segment display codes

PART- B: (Minimum of 3 Experiments has to be performed)

8086 Interfacing

1. Hardware/Software Interrupt Application
2. A/D Interface through Intel 8255
3. D/A Interface through Intel 8255
4. Keyboard and Display Interface through Intel 8279
5. Generation of waveforms using Intel 8253/8254

PART- C: (Minimum of 3 Experiments has to be performed)

8051 Assembly Language Programs

1. Finding number of 1's and number of 0's in a given 8-bit number
2. Addition of even numbers from a given array
3. Ascending / Descending order
4. Average of n-numbers

PART-D: (Minimum of 3 Experiments has to be performed)

8051 Interfacing

1. Switches and LEDs
2. 7-Segment display (multiplexed)
3. Stepper Motor Interface
4. Traffic Light Controller

Equipment Required:

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. 8086 Microprocessor kits
4. 8051 microcontroller kits
5. ADC module
6. DAC module
7. Stepper motor module
8. Keyboard module
9. LED, 7-Segemt Units
10. Digital Multimeters
11. ROM/RAM Interface module

Bread Board etc.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year - II Semester	SKILL ORIENTED COURSE	L	T	P	C
		3	0	0	3
RENEWABLE ENERGY SOURCES					

Course Objectives

The objectives of this course is to acquire knowledge on

vi. solar radiation data, extraterrestrial radiation, radiation on earth's surface.
vii. maximum power point techniques in solar pv and wind.
viii. wind energy conversion systems, Betz coefficient, tip speed ratio.
ix. basic principle and working of hydro, tidal systems
x. basic principle and working biomass, fuel cell and geothermal systems.

UNIT–I:

Fundamentals of Energy Systems

Energy conservation principle, Energy scenario (world and India), Solar radiation**:** Outside earth's atmosphere, Earth surface – Analysis of solar radiation data – Geometry – Radiation on tilted surface, Numerical problems.

UNIT–II:

Solar Thermal Systems

Liquid flat plate collections**:** Performance analysis, Transmissivity, Absorptivity, Product collector efficiency factor, Collector heat removal factor, Numerical problems, Introduction to solar air heaters, Concentrating collectors and solar pond.

UNIT–III:

Solar Photovoltaic Systems

Balance of systems, I-V & P-V characteristics, System design**,** Storage sizing, PV system sizing, Maximum power point techniques**,** Perturb and observe (P&O) technique, Incremental Conductance (INC), Hill climbing technique.

Wind Energy

Wind patterns, Types of turbines, Kinetic energy of wind, Betz coefficient, Tip–speed ratio, efficiency, Power output of wind turbine, Selection of generator (synchronous, induction), Maximum power point tracking.

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, Numerical problems, Wave power-basics, Kinetic energy equation.

UNIT–V:

Biomass, fuel cells and geothermal systems

Biomass Energy**:** Fuel classification – Pyrolysis – Direct combustion of heat– Different digesters and sizing, Fuel cell**:** classification – Efficiency – V-I characteristics–Geothermal**:** classification – Dry rock and acquifer – Energy analysis.

Learning Outcomes:

The students should be able to

vi. analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface.
vii. develop maximum power point techniques in solar PV and wind.
viii. explain wind energy conversion systems, Betz coefficient , tip speed ratio.
ix. explain basic principle and working of hydro, tidal systems
x. explain the basic principle of biomass ,fuel cell and geothermal systems.

Text Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis Electrical and Electronics Engineering 163
3. Energy Science: Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford.

Reference Books:

1. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal,World scientific, Singapore.
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
3. Renewable energy technologies – A practical guide for beginners –Chetong Singh Solanki, PHI.

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III Year - II Semester		**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
IPR & PATENTS (MC)					

Objectives:

i. This course is aimed at familiarizing researchers with the nuances of Intellectual Property Rights (IPR) so as to help them integrate the IPR process in their research activities.
ii. IPR internalization process to help the researchers to set targeted objectives in their research project and also to design and implement their research to clearly differentiate their work vis-a-vis the existing state of knowledge/ prior art.
iii. To give the PhD Students "hands- on –training" in literature, including patent search and documentation of research activities that would aid an IPR expert to draft, apply and prosecute IPR applications.
iv. To make the PhD students familiar with basics of IPR and their implications in Research, development and commercialization.
v. Facilitate the students to explore career options in IPR.

Unit I: Introduction to Intellectual Property Rights (IPR)

Introduction of IPR - Importance - Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO -Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR - Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

Unit II: Copyrights and Neighboring Rights

Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers **–** Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT III: Patents

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Compulsory Licensing — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations

UNIT IV: Trademarks

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing Off Action.

UNIT V: Trade Secrets & Cyber Law and Cyber Crime

Introduction to Trade Secrets – General Principles - Laws Relating to Trade Secrets –

Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements – Breach of Contract –Law of Unfair Competition – Trade Secret Litigation – Applying State Law. Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions – E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers.

Outcomes:

i. IPR Laws and patents pave the way for innovative ideas which are instrumental for inventions to seek Patents.

ii. Student gets an insight on Copyrights, Patents and Software patents which are instrumental for further advancements.

iii. Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems and analyse the social impact of intellectual property law and policy

iv. Analyse ethical and professional issues which arise in the intellectual property law context

v. students should be able to Write reports on project work and critical reflect on their own learning.

References:

i. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi.

ii. Deborah E.Bouchoux: Intellectual Property, Cengage Learning, New Delhi.

iii. PrabhuddhaGanguli: Intellectual Property Rights, Tata Mc-Graw –Hill, New Delhi.

iv. Richard Stim: Intellectual Property, Cengage Learning, New Delhi.

v. Kompal Bansal &Parishit Bansal Fundamentals of IPR for Engineers, B. S. Publications (Press).

vi. Cyber Law - Texts & Cases, South-Western's Special Topics Collections.

vii. R.Radha Krishnan, S.Balasubramanian: Intellectual Property Rights, Excel Books. New Delhi.

viii. M.Ashok Kumar and MohdIqbal Ali: Intellectual Property Rights, Serials Pub.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
UTILZATION OF ELECTRICAL ENERGY (PROFESSIONAL ELECTIVE-III)					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. operating principles and characteristics of electric drives.
ii. different types of electric heating and welding techniques.
iii. basics of illumination and design of lightning system.
iv. features of traction motor and speed time curves.
v. basic principle and method of calculation for tractive effort

UNIT – I:
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.

UNIT – II:
Electric Heating
Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating – Arc furnaces – Direct and indirect arc furnaces
Electric Welding
Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT – III:
Illumination fundamentals
Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Discharge lamps, MV and SV lamps – Lumen or flux method of calculation - Sources of light.
Various Illumination Methods
Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and Design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting.

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-High speed transportation trains.

UNIT – V:
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-Modern traction motors.

Course Outcomes:
The students should be able to

i. identify a suitable motor for electric drives and industrial applications
ii. identify most appropriate heating or welding techniques for suitable applications.
iii. estimate the illumination levels and design
iv. determine the speed/time characteristics of different types of traction motors.
v. estimate energy consumption levels at various modes of operation.

Text Books:
i. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
ii. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai&Sons.

Reference Books:

i. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
ii. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
HIGH VOLTAGE ENGINEERING (PROFESSIONAL ELECTIVE-III)					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. electric field distribution and computation in different configuration of electrode systems.
ii. HV breakdown phenomena in gases, liquids and solids dielectrics.
iii. generating and measuring principle of operation and Design of HVDC, AC and Impulse voltages and currents.
iv. insulating characteristics of dielectric materials.
v. various testing techniques of HV equipments.

UNIT–I:
Introduction to High Voltage Technology
Electric Field Stresses – Uniform and non–uniform field configuration of electrodes – Estimation and control of electric Stress – Numerical methods for electric field computation.

UNIT–II:
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–III:
Generation and Measurement 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.
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.

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.

Course Outcomes:

The student should be able to

i. know the performance of high voltages with regard to different configurations of electrode systems.
ii. know the theory of breakdown and withstand phenomena of all types of dielectric materials.
iii. apply knowledge for measurement of high voltage and high current AC, DC and Impulse.
iv. To be in a position to measure dielectric property of material used for HV equipment.
v. To know the techniques of testing various equipment's used in HV engineering.

Text Books:

i. High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition.
ii. High Voltage Engineering and Technology by Ryan, IET Publishers.

Reference Books:

i. High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 3rd Edition
ii. High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.
iii. High Voltage Insulation Engineering by RavindraArora, Wolfgang Mosch, New Age International (P)Limited,1995

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
SMART GRID TECHNOLOGIES (PROFESSIONAL ELECTIVE-III)					

Course Objectives:

The objectives of this course is to acquire knowledge

i. on the challenging issues and architecture of smart grid
ii. on the communication and wide area monitoring in smart grid
iii. on the rudimentary energy management issues in smart grid
iv.in computational intelligence and security issues in smart grid
v. on the role of Power electronics and energy storage in smart grid

UNIT - I: **SMART GRID ARCHITECTURE**

Challenges in power grid, Advantages of building integrated and distributed power systems concept of smart grid, need for smart grid, smart grid components and their limitations, grid vision based on the intelligent architecture, Whole sale energy market in smart grid, Stake holders roles and function, Approach to smart grid interoperability standards.

UNIT - II: COMMUNICATIONS AND MEASUREMENTS

Latest wired and wireless technologies, Characteristics of smart grid communications technology and communication techniques, Switching techniques and communication channels, Wide area monitoring systems, Phasor measurements units, Key components of smart metering, Communication infrastructure and protocols for smart metering, Advanced metering infrastructure, Multi agent systems for smart grid implementation

UNIT - III: PERFORMANCE ANALYSIS TOOLS

Load flow studies for smart grid, extended formulations and algorithms, Security assessment in smart grid, Contingency studies for smart grid, Voltage stability in smart grid, and Energy management in smart grid.

UNIT - IV: **COMPUTATIONAL TOOLS AND SECURITY**

Introduction to computational tools, Optimization techniques and applications to smart grid, Evolutionary computation techniques and computational challenges, Network security: Encryption and decryption, cyber-attacks, Authentication and cyber security standards

UNIT - V: RENEWABLE ENERGY AND STORAGE

Benefits of renewable generation, Importance of micro grid, Demand response issues, PHEV technology, Energy storage technologies, Grid integration issues of renewable energy sources.

Course Outcomes:

The students should be able to:

i. discuss about the challenging issues and architecture of smart grid
ii. acquire knowledge on the communication and wide area monitoring in smart grid
iii. analyse energy management issues in smart grid
iv. acquire the knowledge in computational intelligence and security issues in smart grid
v. know the role of Power electronics and energy storage in smart grid

Text Books:

i. James Momoh, "Smart Grid – fundamentals of design and analysis", John Wiley and Sons, 2012
ii. Stuart Borlase,"Smart Grids, Infratructure, technology and solutions", CRC press, 2013
iii. Clark W. Gellings, "The Smart Grid- Enabling energy efficiency and demand response", CRC press, 2009

Reference Books:

i.Janaka Ekanayake, "Smart Grid-Technology and Applications", John Wiley and Sons, 2012
ii.Fereidoon P.Sioshansi, "Smart grid- integrating renewable, distributed and efficient energy", Elsevier, 2012

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IV Year - I Semester		L	T	P	C
		3	0	0	3
ELECTRICAL MACHINE MODELLING AND ANALYSIS (PROFESSIONAL ELECTIVE-III)					

Course Objectives

The objectives of this course is to acquire knowledge on

i. unified theory of rotating machines.
ii. concept of phase transformation.
iii. mathematical modeling of machines single phase induction .
iv. develop concepts on mathematical modeling of electrical machines.
v. analyze BLDC Machine and switched reluctance machine based on mathematical modeling of BLDCM and SRM.

UNIT – I

Basic concepts of modeling

Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with andwithout damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

UNIT – II

DC machine modeling

Mathematical model of separately excited D.C Motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C
Motor- Mathematical model of D.C Series motor, Shunt motor-Linearization Techniques for small perturbations.

UNIT- III

Reference frame theory & Modeling of single phase Induction Machines

Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence- Mathematical modeling of single phase induction machines.

UNIT – IV

Modeling of three phase Induction Machine

Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables.

UNIT –V

Modeling of Synchronous Machine

Synchronous machine inductances–voltage equations in the rotor's dq0 reference frame-electromagnetic torque-current in terms of flux linkages-three phase synchronous machine model.

Modeling of Special Machines

Modeling of PM Synchronous motor, modeling of BLDC motor and modeling of Switched Reluctance motor.

Course Outcomes:

The student should be able to

i. discuss about the basic concepts of machine modeling
ii. develop mathematical model of dc motor
iii. acquire knowledge on the abc to dq0 and dq0 to abc transformations to develop mathematical model of single-phase induction machine
iv. design control strategies based on dynamic modeling of 3-ph Induction machines and 3-phase synchronous machine.
v. model synchronous machine and special electrical machines

Text Books:

i. Generalized theory of Electrical Machinery –P.S.Bimbra- Khanna Publishers.
ii. Electric Motor Drives - Modeling, Analysis& control -R.Krishnan- Pearson Publications- 1st edition -2002.

Reference Books:

i. Analysis of Electrical Machinery and Drive systems – P.C.Krause, OlegWasynczuk, Scott D.Sudhoff – Second Edition-IEEE Press.
ii. Dynamic simulation of Electric machinery using Matlab / Simulink –CheeMunOng-PHl.
iii. Modern Power Electronics and AC Drives-B.K. Bose - PHI

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IV Year - I Semester		L	T	P	C
		3	0	0	3
ADVANCED CONTROL SYSTEMS (PROFESSIONAL ELECTIVE-III)					

Course Objectives:
The objectives of this course is to acquire knowledge on
i. formulation of different models using state space analysis
ii. analysis of state feedback control through pole placement technique.
iii. analysis of a nonlinear system using Lypanov's method of stability
iv. formulation of Euler Laugrange equation to optimize typical functional and solutions
v. optimal controller design using LQG framework

UNIT – I:
State space analysis
State Space Representation – Solution of state equation – State transition matrix, –Canonical forms – Controllable canonical form – Observable canonical form, Jordan Canonical Form.

UNIT – II:
Controllability, observability and Design of pole placement
Tests for controllability and observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality – Controllability and observability form Jordan canonical form and other canonical forms – Effect of state feedback on controllability and observability – Design of state feedback control through pole placement.

UNIT – III:
Describing function and stability analysis
Introduction to nonlinear systems, Types of nonlinearities, describing functions, Introduction to phase–plane 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.

Course Outcomes:

The students should be able to

i. design the state space model of control system and formulate different state models
ii. design state feedback control using the pole placement technique
iii. analyse the stability using Lyapunov's method.
iv. minimize the functions using calculus of variation method.
v. design optimal controller using LQG framework

Text Books:

i. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd edition, 1998
ii.Automatic Control Systems by B.C. Kuo, Prentice Hall Publication

Reference Books:

i. Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition,1996
ii. Control Systems Engineering by I.J. Nagarath and M.Gopal, New Age International (P) Ltd.
iii. Digital Control and State Variable Methods – by M. Gopal, Tata McGraw–Hill Companies, 1997

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER SYSTEM OPERATION AND CONTROL (PROFESSIONAL ELECTIVE-IV)					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. optimal dispatch of generation with and without losses.
ii. optimal scheduling of hydro thermal systems.
iii. optimal unit commitment problem.
iv. load frequency control for single and two area systems with and without controllers
v. 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
Optimal scheduling of Hydrothermal System**:** Hydroelectric power plant models – Scheduling problems – Short term hydrothermal scheduling problem.

UNIT–III: Unit Commitment
Optimal unit commitment problem – Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT–IV: Load Frequency Control
Modeling of steam turbine - Modeling of Hydro turbine – Generator – Mathematical modeling of speed governing system – Transfer function –Necessity of keeping frequency constant –Control area – Single area power system – Block diagram representation of an isolated power system – Steady state analysis - Dynamic response of Uncontrolled case. Proportional plus Integral control of single area- Steady State Response .Tie-line bias control, Block diagram development of Load Frequency Control of two area system- uncontrolled case and controlled case, Economic dispatch control.

UNIT–V: Reactive Power Control
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 – Uncompensated and compensated transmission lines**:** Shunt and series compensation – Need for FACTS controllers.

Course Outcomes:
The students should be able to

i. compute optimal scheduling of Generators.
ii. Compute hydrothermal scheduling.
iii. solve unit commitment problem.
iv. design PID controllers in single area and two area systems.

v. apply reactive power control and compensation for transmission line.

Text Books:

i. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–Hill Publishing Company Ltd., Second edition.
ii. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.

Reference Books:

i. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., Thompson,3rd Edition.
ii. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
iii. Power System Analysis by HadiSaadat – TMH Edition.
iv. Power System stability & control, PrabhaKundur,TMH

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IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
EXTRA HIGH VOLTAGE AC TRANSMISSION (PROFESSIONAL ELECTIVE-IV)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. evaluation of different parameters and properties of conductors
ii. electrostatic field application of conductors
iii. effect of corona and radio interference of different fields
iv. over voltage phenomenon of EHVAC Systems
v. various grounding techniques used in Power Systems

UNIT-I: Introduction to EHV AC Transmission:

Calculations of line and ground parameters: Properties of bundled conductors, inductance and capacitance calculations line parameters for modes of propagation resistance and inductance of ground returns, equivalent circuit of line model.

UNIT-II: Voltage Gradients of Conductors:

Electrostatics, Field of Sphere, Field of Line Charges and their Charge-Potential Relations for Multi-Conductor, Surface Voltage Gradient on Conductors, Examples of Conductors and Maximum Gradients on Actual Lines, Gradient Factors and Their Use, Distribution of Voltage Gradient on Sub-conductors of Bundle.

UNIT-III: Corona and Radio interference:

Corona loss formula factors affecting corona. Audible noise, its characteristics, limits for audio noise, relation between single phase and 3-phase AN level, radio interference, limits for radio interference fields, CIGRE formula.

UNIT-IV: Over Voltage in EHV Systems:

Switching surges, causes of switching surge over voltages, recovery voltage, restriking transients, over voltages caused by interruption of low inductance currents, line energization transients, Ferro-resonance over voltages, lightning over voltages, protection against switching and lightning surges, VFTO in GIS, insulation coordination, design example.

UNIT-V: Power System Grounding:

Functional Requirements of Earthing System, Equipment Earthing, Neutral Point Earthing, design of Substation grounding System, analysis of simple grounding systems, dimensioning of Earth Conductors, Step Potential and Touch Potential, body currents due to touch and step voltages, grounding system safety assessment and Earth Mat design. Measurement of Resistance and Soil Resistivity of Earthing System.

Course Outcomes:

The student should be able to

i. evaluate parameters of ehv line modeling
ii. analyze and evaluate electric field and interference characteristics of EHVAC system
iii. analyze the corona loss formulation and radio interference
iv. analyze the over-voltage phenomena and methods to limit in ehv ac systems.
v. design grounding system for EHVAC systems

Text Books:

i. Rakesh Das Begamudre, "Extra High Voltage AC Transmission Engineering", Fourth Edition, New Age International publishers, 2014.
ii. Allen J Wood & Bruce Wollenberg, "Power Generation Operation & Control, Third Edition, 2016.

Reference Books:

i. Turan Gonen, "Electric Power Transmission System Engineering Analysis and Design", CRC Press, Third Edition, 2014
ii. Md. Abdus Salam, Quazi M. Rahman "Power Systems Grounding" Springer publishers, 2016
iii. A Chakraborti, D.P. Kothari and A.K. Mukhopadyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H. (Pub) 1992.

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IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS
(PROFESSIONAL ELECTIVE-IV)

Course Objectives:

The objectives of this course is to acquire knowledge on

i. basics of power flow control in transmission lines using FACTS controllers.
ii. operation and control of voltage and current source converter.
iii. shunt compensation nusing static VAR compensators.
iv. series compensation methods.
v. 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 bridge converter – Square–wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter– Three–phase current source converter – Comparison of current source converter with voltage source converter.

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. Thyristor Switched Capacitor (TSC)–Thyristor Switched Capacitor – Thyristor Controlled Reactor (TSC–TCR). Static VAR compensator (SVC) and Static Compensator (STATCOM)**:** The regulation and slope transfer function and dynamic performance – Transient stability enhancement and power oscillation damping– Operating point control and summary of compensation control.

Unit–IV:

Series Compensators

Static series compensators**:** Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements.

Static Synchronous Series Compensator (SSSC) - GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC).

Unit–V:

Combined Controllers

Schematic and basic operating principles of Unified Power Flow Controller (UPFC) -Interline Power Flow Controller (IPFC)– Application.

Course Outcomes:

The students should be able to

i. know the power flow control in transmission lines using facts controllers.
ii. explain the operation and control of voltage and current source converter
iii. analyze method of shunt compensation using static var compensators.
iv. evaluate different methods of compensations using series compensators.
v. apply unified power flow controller (UPFC) on transmission systems.

Text Books:

i. "Understanding FACTS" N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is available:— Standard Publications, 2001.
ii. Padiyar.K.R, " FACTS Controllers in Power Transmission and Distribution" New Age Int. Publishers, 2007

Reference Books:

i. "Flexible ac transmission system (FACTS)" Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
ii. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv K.Varma, Wiley

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
IV Year - I Semester		**3**	**0**	**0**	**3**
ENERGY AUDITING AND DEMAND SIDE MANAGEMENT (PROFESSIONAL ELECTIVE-IV)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. energy efficiency, scope, conservation and technologies.
ii. design energy efficient lighting systems.
iii. estimation /calculate power factor of systems and propose suitable compensation techniques.
iv. energy conservation in HVAC systems.
v. costing analysis and return on investment on energy efficient technologies.

Unit-I:

Basic Principles of Energy Audit and management

Energy audit - Definitions - Concept - Types of audit - Energy index - Cost index - Pie charts - Sankey diagrams - Load profiles - Energy conservation schemes and energy saving potential - Numerical problems - Principles of energy management - Initiating, planning, controlling, promoting, monitoring, reporting - Energy manager - Qualities and functions - Language - Questionnaire - Check list for top management.

Unit-II:

Lighting

Modification of existing systems - Replacement of existing systems - Priorities: Definition of terms and units - Luminous efficiency - Polar curve - Calculation of illumination level - Illumination of inclined surface to beam- Luminance or brightness - Types of lamps - Types of lighting - Electric lighting fittings (luminaries) - Flood lighting - White light LED and conducting Polymers - Energy conservation measures.

Unit-III:

Power Factor and energy instruments

Power factor - Methods of improvement - Location of capacitors - Power factor with non linear loads - Effect of harmonics on Power factor - Numerical problems. Energy Instruments - Watt-hour meter - Data loggers Thermocouples - Pyrometers - Lux meters - Tong testers - Power analyzer.

Unit-IV:

Space Heating and Ventilation

Ventilation - Air-Conditioning (HVAC) and Water Heating: Introduction - Heating of buildings - Transfer of Heat-Space heating methods - Ventilation and air-conditioning - Insulation-Cooling load - Electric water heating systems - Energy conservation methods.

Unit-V

Economic Aspects and Analysis

Economics Analysis - Depreciation Methods - Time value of money - Rate of return - Present worth method - Replacement analysis - Life cycle costing analysis - Energy efficient motors (basic concepts).

Calculation of simple payback method - Net present worth method - Power factor correction - Lighting - Applications of life cycle costing analysis - Return on investment.

Course Outcomes:

The student should be able to

i. explain energy efficiency, conservation and various technologies.
ii. design energy efficient lighting systems.
iii. calculate power factor of systems and propose suitable compensation techniques.
iv. explain energy conservation in HVAC systems.
v. calculate life cycle costing analysis and return on investment on energy efficient technologies.

Text Books:

i. Energy management by W.R. Murphy & G. Mckay Butter worth, Elsevier publications. 2012
ii. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995

Reference Books:

i. Electric Energy Utilization and Conservation by S C Tripathy, Tata McGraw hill publishing company Ltd. New Delhi.
ii. Energy management by Paul o' Callaghan, Mc-Graw Hill Book company-1st edition, 1998.
iii. Energy management hand book by W.C.Turner, John wiley and sons.
iv. Energy management and conservation –K V Sharma and P Venkata Seshaiah-I K International Publishing House pvt.ltd,2011.
v. http://www.energymanagertraining.com/download/Gazette of IndiaPartIISecI-37 25-08-2010.pdf

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER QUALITY **(PROFESSIONAL ELECTIVE-IV)**					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. different types of power quality phenomena and identify sources for voltage sag, voltage swell, interruptions, transients, long duration over voltages and harmonics in a power system.
ii. power quality terms and study power quality standards.
iii. the principle of voltage regulation , power factor improvement methods and study the effect the harmonic distortion and its solutions.
iv. the relationship between distributed generation and power quality.
v. the power quality monitoring concepts and the usage of measuring instruments

UNIT – I: Introduction and Voltage imperfections in power systems

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- Power quality terms – Voltage sags, Voltage swells,harmonics interruptions, voltage flicker and voltage spikes – Sources of voltage sag, swell and interruptions – Nonlinear loads. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection – Utility capacitor switching transients.

UNIT – II: Voltage Regulation and power factor improvement:

Principles of regulating the voltage – Device for voltage regulation – Utility voltageregulator 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 - III: 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 - IV: Distributed Generation and Power Quality

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

UNIT - V: Monitoring and Instrumentation

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards

Course Outcomes:

The students should be able to

i. know the different types of power quality problems and analyze power quality terms and power quality standards
ii. explain the principle of voltage regulation and power factor improvement methods.
iii. analyze the effect the harmonic distortion and its solutions..
iv. demonstrate the relationship between distributed generation and power quality.
v. knowthe power quality monitoring concepts and the usage of measuring instruments.

Text Books:

i. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw–Hill, 2012, 3rd edition.
ii. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley India publications,2011

Reference Books:

i. Power Quality Primer, Kennedy B W, First Edition, McGraw–Hill, 2000.
ii. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M HJ, First Edition, IEEE Press; 2000.
iii. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley& Sons, 2003.
iv. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, VanNostrad Reinhold, New York.
v. Power Quality C.Shankaran, CRC Press, 2001
vi. Harmonics and Power Systems –Franciso C.DE LA Rosa–CRC Press (Taylor &Francis

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
AI APPLICATIONS IN ELECTRICAL ENGINEERING (PROFESSIONAL ELECTIVE-V)					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. basics of Artificial Intelligence system, ANN architectures and learning strategies.
ii. learning rules and algorithms
iii. properties, operations and relations of fuzzy sets.
iv. fuzzification and defuzzification methods to develops fuzzy logic system.
v. various applications of AI in electrical engineering such as Load frequency control, Economic load dispatch, stability and speed control of DC motor etc.

UNIT - I: Introduction to AI techniques
Introduction of AI system, Historical Developments, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Characteristics of ANN.

UNIT - II: ANN paradigm
McCulloch-Pitts Model, Learning Rules, Generalized Delta Rule, Single-layer feed-forward networks: – Perceptron, learning algorithm for perceptron- limitations of Perceptron model, Multi-layer feed-forward network (based on Back propagation algorithm)– Derivation of Back propagation (BP) Training, Summary of Backpropagation Algorithm, Radial-basisfunction networks- Recurrent networks (Hopfield networks).

UNIT - III: Classical & Fuzzy Sets
Introduction to classical sets – operations, properties and relations of Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT - IV: Components of Fuzzy Logic System
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT - V: Applications of AI Techniques
Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area and two area power system, Small Signal Stability, Reactive power control, speed control of DC and AC Motors.

Course Outcomes:

The students should be able to:

i discuss about the Artificial Neuron Models, ANN architectures and learning strategies
ii acquire knowledge on various learning algorithm of ANN.
iii differentiate classical and fuzzy sets.
iv apply the Fuzzification and defuzzification methods to design a Fuzzy logic controller.
v apply of AI Technique to Electrical engineering applications such as Load frequency control, Economic load dispatch, stability and speed control of DC motor etc.

Text Books:

i. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Pai – PHI Publication.
ii. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH,2006
iii. Fuzzy Logic with Engineering Applications by Timothy J. Ross

Reference Books:

i. Jack M. Zurada, "Introduction to Artificial Neural Systems", PWS Publishing Co., Boston, 2002. Klir G.J. &Folger T.A., "Fuzzy sets, Uncertainty and Information", Prentice –Hall of India Pvt. Ltd., New Delhi, 2008.
ii. Zimmerman H.J., "Fuzzy set theory and its Applications", Kluwer Academic Publishers Dordrecht, 2001.
iii. Driankov, Hellendroonb, "Introduction to fuzzy control", Narosa Publishers, 2001.
iv. Neural Networks – Simon Hakins , Pearson Education
v. Neural Engineering by C.Eliasmith and CH.Anderson, PHI
vi. Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
HYBRID ELECTRIC VEHICLES (PROFESSIONAL ELECTIVE-V)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. advantages of electric and hybrid electric vehicles.
ii. various architectures of hybrid electric vehicles.
iii. power management of plug in electric vehicles.
iv. different power converters used in electrical vehicles.
v. 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, principle of magnetic levitation, 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.
UNIT– V:
Battery and Storage Systems
Energy Storage Parameters; Lead–Acid Batteries; Lithium-ion batteries-Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource

Course Outcomes:
The student should be able to:

i. know the concept of electric vehicles and hybrid electric vehicles.

ii. familiar with different configuration of hybrid electric vehicles.
iii. apply the power management used in hybrid electric vehicles
iv. apply the power converters used in hybrid electric vehicles
v. know different batteries and other energy storage systems.

Text Books

i. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
ii. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

i. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
ii. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
iii. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.

ResearchBooks:

i. Pistooa G., “Power Sources , Models, Sustanability, Infrstructure and the market”, Elsevier 2008
ii. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
IoT APPLICATIONS IN ELECTRICAL ENGINEERING (PROFESSIONAL ELECTIVE-V)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. architecture and various technologies of Internet of Things.
ii. communication technologies used in the Internet of Things.
iii. connectivity of devices using web and internet in the IoT environment.
iv. various data acquisition methods and data handling using cloud for IoT applications.
v. IoT implementation for 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.

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.

Course Outcomes:

the students should be able to

i. know the various fundamentals, architectures and technologies of Internet of Things.
ii. discuss about various communication technologies used in the Internet of Things.
iii. acquire knowledge on the various device connectivity methods using web and internet in the IoT environment.
iv. explore various data acquisition methods, data handling using cloud for IoT applications.
v. apply IoT to design Smart Home, Smart city, agriculture practices etc.

Text Books:

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

Reference Books:

i. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, First edition, 2013.
ii. Getting Started with the Internet of Things, CunoPfister, O'reilly, 2011.
iii. Internet of Things : A Hands-on Approach, Arshdeep Bahga, and Vijay Madisetti, 2014

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
ELECTRICAL DISTRIBUTION SYSTEMS (PROFESSIONAL ELECTIVE-V)					

Course Objectives

The objectives of this course is to acquire knowledge on

i. different factors of Distribution system.
ii. designing the substations and distribution systems.
iii. concepts of voltage drop and power loss in a distribution system.
iv. distribution system protection and its coordination.
v. effect of compensation for power factor improvement and effect of voltage control on distribution system.

UNIT – I:

General Concepts

Introduction to distribution systems, Load modeling and characteristics – Coincidence factor – Contribution factor-loss factor – Relationship between the load factor and loss factor – Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II:

Substations & Distribution Feeders

Location of substations**:** Rating of distribution substation – Service area with'n'primary feeders – Benefits and methods of optimal location of substations..

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.

UNIT – IV:

Protective devices and Coordination

Objectives of distribution system protection – Types of common faults and procedure for fault calculations for distribution system – Protective devices**:** Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers, Co ordination of protective devices**,** General coordination procedures - Various types of coordinated operation of protective devices - Residual Current Circuit Breaker

UNIT – V:

Compensation for Power Factor Improvement and Voltage Control

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. Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Learning Outcomes:

The students should be able to

i. discuss about various factors of distribution system.
ii. design the substation and feeders.
iii. determine the voltage drop and power loss
iv. apply the protection and coordination of distribution system.
v. apply compensation techniques for power factor improvement in a distribution system

Text Book:

i. "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill Book Company.

Reference Books:

i. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press
ii. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing company, 4th edition, 1997.
iii. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers

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UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
DIGITAL CONTROL SYSTEMS (PROFESSIONAL ELECTIVE-V)					

Course Objectives:
The objectives of this course is to acquire knowledge on

i. basic concepts of digital control systems and its associate components.
ii. z–transformation theory and its application for the mathematical analysis of digital control systems.
iii. discrete–time systems in state–space model and evaluation of state transition matrix.
iv. testing of stability criteria using different stability tests.
v. design of state feedback control by the pole placement method.

UNIT – I:
Introduction and signal processing
Introduction to analog and digital control systems – Advantages of digital systems – Typical examples – Signals and processing – 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 – State transition matrix and methods of evaluation – Discretization of continuous – Time state equations – Concepts of controllability and observability – Tests (without proof).

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 and state feedback controllers
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

State feedback controllers:
Design of state feedback controller through pole placement – Necessary and sufficient conditions – Ackerman's formula.

Course Outcomes:

The students should be able to

i. know the various components of digital control systems and its advantages compared to analog systems.
ii. Apply z–transformation theory for the mathematical analysis of digital control systems.
iii. represent the state–space model of discrete–time systems and determination of state transition matrix.
iv. examine the Stability of the system using Routh's and Jury's stability test.
v. apply root locus technique in the z–plane and also able to design state feedback controller through pole placement method.

Text Books:

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

Reference Books:

i. Digital Control Systems, B.C Kuo, Oxford University Press, 2nd Edition, 2003.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
ELECTRIC VEHICLES **(OPEN ELECTIVE-III)**					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. basics concepts related to mechanics, kinetics and dynamics of electric vehicles.
ii. technical characteristics and properties of batteries.
iii. different ratings of motor and engine to design an electric vehicle.
iv. various components of electric vehicle drive.
v. different configurations of drive train.

UNIT I ELECTRIC VEHICLES
Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II BATTERY
Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III DC & AC ELECTRICAL MACHINES
Motor and Engine rating, Requirements, DC machines, Three phase A.C machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV ELECTRIC VEHICLE DRIVE TRAIN
Transmission configuration, Components – gears, differential, clutch, brakes regenerative braking, motor sizing.

UNIT V HYBRID ELECTRIC VEHICLES
Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Course Outcomes:

the students should be able to,

i. design propulsion system for an electric vehicle.

ii. know technical characteristics and properties of batteries and also to design battery pack.

iii. know the ratings and requirements of electrical machines.

iv. apply the regenerative braking and sizing of motors.

v. configure and design the components of hybrid electric vehicles.

Text book(s) and/or required materials

i. IqbalHussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
ii. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

Reference Books:

i. MehrdadEhsani, YiminGao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
ii. SandeepDhameja, "Electric Vehicle Battery Systems", Newnes, 2000
http://nptel.ac.in/courses/108103009/

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
IV Year - I Semester		**3**	**0**	**0**	**3**
INDIAN ELECTRICITY ACT, 2003 (OPEN ELECTIVE-IV)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. national policy and plan and the joint responsibilities of state and central governments

ii. licensing and the provisions related to transmission and distribution of electricity

iii. regulatory commissions and cea

iv. appellate tribunal for electricity

v. special courts and dispute resolution

UNIT - I: National electricity policy and plan, generation of electricity

Electricity Act: commencement, definitions, comments; national policy on standalone systems, non-conventional energy systems, electrification and local distribution for rural areas; joint responsibilities of state and central governments in rural electrification, requirement for setting up of generating station, hydro-electric generation, captive generation; duties of generating companies.

UNIT - II: Licensing, transmission and distribution of electricity

Licensing: powers, procedures, conditions, amendments, revocation, provisions, directions, suspension and sale; inter-state and intra-state transmission; other provisions relating to transmission; provisions with respect to distribution licenses, electricity traders, supply -consumer protection: standard performance

UNIT - III: Tariff, works, CEA and Regulatory commissions

Works of licenses, provisions relating to overhead lines; Constitution and functions of Central Electricity Authority (CEA), directions and certain powers; Constitution, powers and functions of state and central commissions, other provisions, proceedings and powers of appropriate commission, Grants, Fund, Accounts Audit and Report

UNIT - IV: Appellate Tribunal, Reorganisation of boards, offences and penalty

Appellate Tribunal for electricity; investigation and assessment; reorganisation of boards; Offences and penalties

UNIT - V: Special courts, Dispute resolution, other provisions and Miscellaneous

Constitution of special courts, procedures, powers, appeal, revision; arbitration; protective clauses; miscellaneous and enactments.

Course Outcomes:

The students should be able to

i. learn about national policy and plan and the joint responsibilities of state and central governments

ii. knowledge on licensing and the provisions related to transmission and distribution of electricity
iii. regulatory commissions and cea
iv. appellate tribunal for electricity
v. special courts and dispute resolution

Text Books:

i. The Electricity Act, 2003 {Act 36 of 2003, dt.2-6-2003, w.e.f. 10-6-2003 vide S.O. No. 669(E), dt. 10-6-2003] published by Commercial Law Publishers (I) Pvt. Ltd.

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IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
POWER SYSTEMS FOR DATA CENTERS (OPEN ELECTIVE-III)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. the primary power problems
ii. working of ups
iii. power distribution in the data centers
iv. power consumption in the data centers
v. impacts of energy efficiency

UNIT -I: Fundamentals of Power

Power basics and key terms, Power calculations, Grounding Power problems, Power protection system equipment

UNIT -II: Uninterruptible Power Supply (UPS)

UPS basics, UPS topologies, UPS redundancy and efficiency, Modular UPS, UPS batteries
Flywheel UPS

UNIT –III: Generators and Other Power Devices

Generators, Automatic and static transfer switches, Power distribution units, Circuit Breakers
Circuit Breaker Coordination, Circuit Breaker Protection, Circuit Breaker Sizing

UNIT –IV: Power Distribution in the Rack

Rack power redundancy, Server power calculations, Power cabling, calculating power requirements, Power consumption in the data centre, Reducing Wasted Power in the Data Centre: reducing server power

UNIT –V: Data Center Energy Efficiency and practices

Data centre power growth, Barriers to data centre energy efficiency, Power consumption in the data centre, Power Usage effectiveness (PUE), Measuring PUE, Other data centre efficiency metrics

Energy Efficiency Best Practices
Reducing the support infrastructure load, Systematic approach to improving energy efficiency.

Course Outcomes:

The students should be able to

i. describe the power infrastructure in the data centre
ii. describe the UPS systems and components
iii. discuss about the electrical equipment, systems and their controls
iv. calculate power required in the data centre
v. describe methods to improve data centre energy efficiency

Text Books:

i. Data Center Handbook, by HwaiyuGeng, **Publisher(s): Wiley ISBN: 9781118436639**

Reference Books:

i. Designing Data Centers - Book 1: Power: Specifying the requirements, power generation, power distribution, power efficiency, and fault tolerance for data centers, by byB.A.Ayomaya, ISBN-13 : 979-8695727715

ii. Guide to Data Centre Power Systems, Publication Year: 2021, Pages: 278 ISBN-13: 978-1-78561-828-4

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
CONCEPT OF POWER ENGINEERING (OPEN ELECTIVE-IV)					

Course Objectives:

The objectives of this course is to acquire knowledge on

i. various power generating stations
ii. analysis of Transmission line parameters
iii. concepts of DC and AC distribution systems along with voltage drop calculations.
iv. various power system protection devices
v. basic principle of electric traction

UNIT – I: Introduction to the Sources of Energy

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 & operation of thermal plant

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.

UNIT – II: Parameters of Transmission line

Types of conductors - calculation of resistance for solid conductors - Calculation of inductance for single phase and three phase, concept of GMR & GMD- Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance. Classification of Transmission Lines and their model representations -Nominal-T, Nominal-π, Ferranti effect - Numerical Problems.

UNIT – III: Distribution Systems

Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor

UNIT-IV : Protective devices

Principle of operation of HRC fuses – SF_6, oil circuit breakers, circuit reclosures and Line sectionalizes

UNIT–V: Electric Traction

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.

Course Outcomes:

The students should be able to

i. analyze the working of thermal and nuclear power generating stations
ii. determine r,l,c parameters and analyze nominal π and t models of transmission lines
iii. determine dc and ac distribution systems along with voltage drop calculations.
iv. analyze the operation of fuses and circuit breakers
v. determine the speed/time characteristics of different types of traction motors.

Text Books:

i. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.
ii. 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.
iii. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.

Reference Books:

i. Electrical Power Systems by P.S.R. Murthy, B.S. Publications.
ii. Art & Science of Utilization of electrical Energy – by Partab, DhanpatRai & Sons.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		L	T	P	C
		3	0	0	3
FUNDAMENTALS OF SMART GRID TECHNOLOGIES (OPEN ELECTIVE-IV)					

Course Objectives:
The objective of this course is to acquire knowledge on
i. various aspects of the smart grid.
ii. smart grid design to meet the needs of a utility.
iii. issues and challenges that remain to be solved.
iv. basics of electricity, electricity generation, economics of supply and demand.
v. various aspects of electricity market operations in both regulated and deregulated environment

UNIT - I: Introduction to Smart Grid & Evolving it to a Perfect Power System:
Introduction: Introduction to smart grid- Electricity network-Local energy networks- Electric transportation-Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid.
Smart Grid to Evolve a Perfect Power System: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems-Fully integrated power system-Nodes of innovation.

UNIT - II: DC Distribution and Smart Grid
AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood-Potential future work and research.
Intelligrid Architecture for the Smart grid: Introduction- Launching intelligrid- Intelligridtoday- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies. SCADA, synchro phasors (WAMS)

UNIT – III: Dynamic Energy Systems Concept
Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems- Integrated communications architecture-Energy Management-Role of technology in demand response-Current limitations to dynamic energy management-Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices- Key characteristics of advanced whole building control systems-Key characteristics of dynamic energy management system.

UNIT - IV: Energy Port as a Part of The Smart Grid & Market Implementation
Energy Port as Part of The Smart Grid: Concept of energy -Port, generic features of the energy port. Policies and Programs to Encourage End – Use Energy Efficiency: Policies and programs in action -multinational - national-state-city and corporate levels.
Market Implementation: Framework-factors influencing customer acceptance and response
- program planning-monitoring and evaluation.

UNIT - V: Efficient Electric End – Use Technology Alternatives

Existing technologies – lighting - Space conditioning - Indoor air quality - Domestic water heating - hyper efficient appliances - Ductless residential heat pumps and air conditioners - Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances - Data center energy efficiency-LED street and area lighting - Industrial motors and drives - Equipment retrofit and replacement - Process heating - Cogeneration, Thermal energy storage - Industrial energy management programs - Manufacturing process-Electro-technologies, Residential, Commercial and industrial sectors.

Course Outcomes:

The students should be able to:

i. recite the structure of an electricity market in either regulated or deregulated market conditions.
ii. analyze the advantages of dc distribution and developing technologies in distribution.
iii. discriminate the trade-off between economics and reliability of an electric power system
iv. analyze the development of smart domestic system.
v. analyze the development of intelligent domestic system.

Text Books:

i. The Smart Grid, Enabling Energy Efficiency and Demand SideResponse, Clark W Gellings, CRC Press, 2009.
ii. Smart Grids, Jean Claude Sabonnadiere, Nouredine Hadjsaid, Wiley-ISTE, IEEEPress, May 2012.
iii. SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

Reference Books:

i. Smart Grid: Technology and Applications, Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, NickJenkins, Wiley, 2012.
ii. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEEPress, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year - I Semester		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
DISTRIBUTION AUTOMATION (OPEN ELECTIVE-IV)					

Course Objectives:

The objective of this course is to acquire knowledge on

i. awareness of the problems and challenges of the present-day distribution sector
ii. knowledge of principles of Distribution Automation (DA)
iii. various communication technologies available for DA
iv. understand the technical Benefits of automation of distribution system
v. principles of various Economic Evaluation Methods of DA.

UNIT-I: DISTRIBUTION AUTOMATION AND THE UTILITY SYSTEM

Introduction to Distribution Automation (DA), Control System Interfaces, Control and Data Requirements, Centralized (Vs) Decentralized Control, DA System (DAS), DA Hardware, DAS Software.

UNIT-II: DISTRIBUTION AUTOMATION FUNCTIONS

DA Capabilities, Automation System Computer Facilities, Management Processes, Information Management, System Reliability Management, System Efficiency Management, Voltage Management, Load Management, Management Process (Function) Interaction, Operating and Objective Priorities.

UNIT-III: COMMUNICATION SYSTEMS FOR DA

DA Communication Requirements - Communication Reliability, Cost Effectiveness, Data Rate Requirements, Two Way Capability, Ability to communicate during outages and faults, Ease of Operation and Maintenance, Conforming to the Architecture of Data Flow. Communication

Systems used in DA - Distribution Line Carrier (Power line carrier), Ripple Control, Zero Crossing Technique, Telephone, Cable TV, Radio, AM Broadcast, FM SCA, VHF Radio, UHF Radio, Microwave, Satellite, Fibre Optics, Hybrid Communication Systems, Communication Systems used in Field Tests.

UNIT-IV TECHNICAL BENEFITS

DA Benefit Categories, Capital Deferred Savings, Operation and Maintenance Savings, Interruption Related Savings, Customer-related Savings, Operational Savings, Improved Operation, Function Benefits, Potential Benefits for Functions, Function-shared Benefits, Guidelines for Formulation of Estimating Equations,

Parameters Required, Economic Impact Areas, Resources for determining benefits, Integration of System Benefits into Economic Evaluation, Impact of DA on Distribution System.

UNIT-V: ECONOMIC EVALUATION METHODS

Development and Evaluation of Alternate Plans, Select Study Area, Select Study Period, Project Load Growth, Develop Alternatives, Calculate Operation and Maintenance Costs, Evaluate Alternatives.

Economic Comparison of Alternate Plans: Classification of Expenses and Capital Expenditures, Comparison of Revenue Requirements of Alternative Plans, Book Life and Continuing Plant Analysis, Year-by- Year Revenue Requirement Analysis, Short Term Analysis, End of Study Adjustment, Break-Even Analysis, Sensitivity Analysis, Major Steps in Utility Economic Evaluation of DA (Flow-Chart) Computational Aids.

Course Outcomes:

The student should be able to

i. know the basic principles of distribution and automation
ii. analyze the working functions of distribution automation
iii. select appropriate Communication Technology for various parts of Distribution System for their automation.
iv. consider all factors for formulation of the Benefit Estimation Equation for estimating DA Benefits.
v. choose appropriate method for Economic Evaluation of DA plans.

Text Books:

i. Dr.M.K. Khedkar and Dr.G.M.Dhole," A Textbook of Electric Power Distribution Automation", University Science Press (Laxmi Publications Pvt. Ltd.), 2011
ii. D. Bassett, K. Clinard, J. Grainger, S. Purucker, and D. Ward, "Tutorial Course: Distribution Automation", IEEE Tutorial Publication 88EH0280-8-PWR, 1988.

Reference Books:

i. James Northcote-Green, Robert Wilson "Control and Automation of Electrical Power Distribution Systems" CRC Press, Taylor and Francis Group, 2007.
ii. James A. Momoh "Electric Power Distribution, Automation, Protection, and Control", CRC Press, Taylor and Francis Group,

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

		L	T	P	C
IV Year - I Semester		**3**	**0**	**0**	**3**
UNIVERSAL HUMAN VALUES-2: UNDERSTANDING HARMONY					

Course Objectives:

i. To Development of a holistic perspective based on self-exploration about themselves(human being), family, society and nature/existence.
ii. To Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
iii. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
iv. To Strengthening of self-reflection.
v. To Development of commitment and courage to act.

Unit-I: Need, Basic Guidelines, Content and Process for Value Education

Purpose and motivation for the course, recapitulation from Universal Human Values-I - Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facility- the basic requirements forfulfilment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmonyat various levels.

Unit-II: Understanding Harmony in the Human Being - Harmony in Myself!

Understanding human being as a co-existence of the sentient 'I' and the material'Body' - Understanding the needs of Self ('I') and 'Body' - happiness and physical facility - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Health.

Unit-III: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship - Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Unit-IV: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature - Understanding Existence as Co-existence of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence.

Unit-V: Implications of the above Holistic Understanding of Harmony on Professional Ethics

Natural acceptance of human values - Definitiveness of Ethical Human Conduct
Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologistsand managers b. At the level of society: as mutually enriching institutions and organizations.

Course Outcomes:

i. Students are expected to become more aware of themselves, and their surroundings(family, society, nature)
ii. They would become more responsible in life, and in handling problems withsustainable solutions, while keeping human relationships and human nature in mind.
iii. They would have better critical ability.
iv. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
v. It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOKS:

i. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values andProfessional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1
ii. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

REFERENCES:

i. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
ii. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
iii. The Story of Stuff (Book).
iv. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
v. E. FSchumacher. "Small is Beautiful"
vi. Slow is Beautiful –Cecile Andrews
vii. J C Kumarappa "Economy of Permanence"
viii. Pandit Sunderlal "Bharat Mein Angreji Raj"
ix. Dharampal, "Rediscovering India"
x. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
xi. India Wins Freedom - Maulana Abdul Kalam Azad
xii. Vivekananda - Romain Rolland(English)
xiii. Gandhi - Romain Rolland (English)

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year- I Semester	SKILL ORIENTED COURSE				
MICRO GRID TECHNOLOGIES		**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

Course Objectives:
The objectives of this course is to acquire knowledge on

i. various automotive power semiconductor devices.
ii. applications of diodes and analysis of uncontrolled rectifiers.
iii. applications of thyristors and analysis of controlled rectifiers.
iv. analysis of three-phase boost type rectifiers under unbalanced Operating conditions.
v. Power electronic components and their control for Hybrid and Fuel Cell Vehicles.

UNIT-I: ENERGY AND CIVILIZATION

Introduction, Depletion of Energy Resources, An Alternative Energy Source-Nuclear Energy, Green and Renewable Energy Sources, Solar and Photovoltaic, Geothermal, Biomass, Energy Units and Conversions, Estimating the Cost of Energy.

UNIT-II: POWER GRIDS:

Introduction, Electric Power Grids, The Construction of a Power Grid System, The Basic Concepts of Power Grids, Common Terms, Calculating Power Consumption, Load Models, Transformers in Electric Power Grids, A Short History of Transformers, Transmission Voltage, Transformers, Modeling a Micro-grid System, Modeling Three-Phase Transformers, Modeling transmission Lines.

UNIT-III: MODELING CONVERTERS IN MICROGRID POWER SYSTEMS: Introduction, Single-Phase DC/AC Inverters with Two Switches, Single-Phase DC/AC Inverters with a Four-Switch Bipolar Switching Method Pulse Width Modulation with Unipolar Voltage Switching fora Single-Phase Full-Bridge Inverter Three-Phase DC/AC Inverters Pulse Width Modulation Methods The Triangular Method The Identity Method Analysis of DC/AC Three-Phase Inverters Microgrid of Renewable Energy Systems The DC/DC Converters in Green Energy Systems The Step-Up Converter The Step-Down Converter The Buck-Boost Converter Rectifiers

UNIT– IV: MICROGRID SOLAR ENERGY SYSTEMS:

Introduction, The Solar Energy Conversion Process, Thermal Power Plants, Photovoltaic Power Conversion, Photovoltaic Materials, Photovoltaic Characteristics, Photovoltaic Efficiency, The Design of Photovoltaic Systems, The Modeling of a photovoltaic Module, The Measurement of Photovoltaic Performance, The Maximum Power Point of a Photovoltaic Array ,A Battery Storage System ,A Storage System Based on a Single-Cell Battery ,The Energy Yield of a Photovoltaic Module and the Angle of Incidence , The State of Photovoltaic Generation Technology , The Estimation of Photovoltaic Module Model Parameters

UNIT–V: MICROGRID WIND ENERGY SYSTEMS

introduction, wind power, wind turbine generators, the modeling of induction machines, calculation of slip , the equivalent circuit of an induction machine , power flow analysis of an induction machine, the operation of an induction generator, dynamic performance, the doubly-fed induction generator, brushless doubly-fed induction generator systems , variable-speed permanent magnet generators, a variable-speed synchronous generator , a variable-speed generator with a converter isolatedfrom the grid.

Course Outcomes:

The students should be able to

i. identify the Various automotive semiconductor devices.
ii. design and analyze the uncontrolled diode rectifiers.
iii. design and analyze the controlled thyristor rectifiers.
iv. operate Three-Phase Boost Type Rectifiers under unbalanced conditions**.**
v. control Hybrid and Fuel Cell Vehicles using Power Electronics components.

Text Books:

i. Automotive Power Electronics And Motor Drives, ALI EMADI, by CRC Press Taylor &Francis Group,LLC,2005.
ii. N. Mohan, T. Undeland, and W. Robbins, Power Electronics: Converters, Applications andDesigns, Wiley, New York, 1989.
iii. R. Jurgen (Ed.), Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, New York,1999.

Reference Books:

i. J. Kassakian et al., Principle of Power Electronics, John Wiley & Sons, New Yo
ii. N. Mohan et al., Power Electronics, 2nd Ed., John Wiley & Sons, New York, 1995.
iii. K. Ogata, Modern Control Engineering, 2nd Ed., Prentice Hall, Englewood Cliffs, NJ, 1990.
iv. A.V. Stankovic and T.A. Lipo. A Generalized Control Method for Input-Output Harmonic Elimination for the PWM Boost Type Rectifier Under Simultaneous Unbalanced Input Voltages and Input Impedances. Proceedings of IEEE PESC, Vancouver, pp. 1309–1314, 2001.
v. S. Yongsug, V. Tieras, and T.A. Lipo. A Nonlinear Control of the Instantaneous Power in d-q Synchronous Frame for PWM AC/DC Converter Under Generalized Unbalanced Oper- ating Conditions. Conference Record of the 2002 IEEE Industry Applications Conference, Chicago, pp. 1189–1196, 2002.
vi. J. Botti and C. Miller, Powertrains of the Future: Reducing the Impact of Transportation on the Environment, SAE 1999 World Congress, March 1–4, 1999, Detroit, MI.

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S. No	Course Code	Course Category	Course Title	L	T	P	C
1	R204202PR01	Major project/ PROJ	Project work, seminar, and internship in industry	0	0	0	12
INTERNSHIP (6 MONTHS)							
Total Credits = 12							

UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)
Courses offered for HONORS Degree

Note:
1. The subjects opted for Honors should be advanced type which are not covered in regular curriculum
2. Students have to acquire 16 credits with minimum one subject from each pool.
3. Concerned BoS can add or delete the subjects as per the decision of the board.
4. Prerequisites to be defined by the board for each course.
5. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each)

POOL-1	**Pre-Requisites**
5. Advanced Power system protection	Basics of power system protection
6. Power system reliability	Basics of Power distribution
7. Power Systems dynamics and Stability	Basics of Power system analysis
8. Economic operation of Power system	Power system operation and control
POOL-2	**Pre-Requisites**
5. Advance Power Electronics	Basics of Power Electronics
6. Advanced Power Electronic Converters	Basics of Power Electronics
7. Power Quality & Custom Power devices	Power quality issues
8. Automotive Power Electronics	Basics of Power Electronics
POOL-3	**Pre-Requisites**
5. Modern Control Systems	Basics of Control systems
6. Discrete Control Systems	Basics of digital control systems
7. Process Dynamics and Control	Basics of control systems
8. Optimal Control Theory	Fundamentals of Optimization techniques
POOL-4	**Pre-Requisites**
5. Advanced Electrical Machines	Electrical Machines
6. Special Electric Machines	Electrical Machines
7. Unified Theory of Electrical Machines	Machine Modelling and Analysis
8. Advanced Electric Drives	Electric Drives
POOL-5	**Pre-Requisites**
5. Distributed Generation & Micro grids	Renewable Energy Sources
6. Smart grid technologies	Renewable Energy Sources
7. Grid Integration of Renewable Energy Systems	Renewable Energy Sources
8. SCADA and Energy Management Systems	Electrical Distribution & Automation

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POOL-1: POWER SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
ADVANCED POWER SYSTEM PROTECTION				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. classification and operation of static relays.
ii. basic principles and application of comparators.
iii. static version of different types of relays.
iv. to understand about numerical protection techniques.
v. microprocessor based relays and their applications

UNIT – I: **STATIC RELAYS CLASSIFICATION AND TOOLS:**
Comparison of Static with Electromagnetic Relays, Basic classification, Level detectors and Amplitude and phase Comparators – Duality – Basic Tools – Schmitt Trigger Circuit, Multivibrators, Square wave Generation – Polarity detector – Zero crossing detector – Thyristor and UJT Triggering Circuits. Phase sequence Filters – Speed and reliability of static relays.

UNIT – II: AMPLITUDE AND PHASE COMPARATORS:
Generalized equations for Amplitude and Phase comparison – Derivation of different characteristics of relays – Rectifier Bridge circulating and opposed voltage type amplitude comparators – Averaging & phase splitting type amplitude comparators – Principle of sampling comparators.
Phase Comparison: Block Spike and phase Splitting Techniques – Transistor Integrating type,
phase comparison, Rectifier Bridge Type Comparison – Vector product devices.

UNIT – III: STATIC OVER CURRENT (OC) RELAYS:
Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings

UNIT – IV: PILOT RELAYING SCHEMES: Wire pilot protection: circulating current scheme – balanced voltage scheme – translay scheme – half wave comparison scheme - carrier current protection: phase comparison type – carrier aided distance protection – operational comparison of transfer trip and blocking schemes – optical fibre channels.

UNIT-V: MICROPROCESSOR BASED RELAYS AND NUMERICAL PROTECTION:
Introduction – over current relays –impedance relay – directional relay – reactance relay.
Numerical Protection: Introduction - numerical relay - numerical relaying algorithms – Mann Morrison technique - Differential equation technique and discrete fourier transform technique

numerical over current protection - numerical distance protection.

Course Outcomes:

The student should be able to

i. know the classifications and applications of static relays.
ii. analyze the application of comparators.
iii. know the static version of different types of relays.
iv. applications and numerical protection techniques.
v. analyze the importance and applications of microprocessor-based relays

Text Books:

i. Power System Protection with Static Relays – by TSM Rao, TMH.
ii. Power system protection & switchgear by Badri Ram & D N Vishwakarma, TMH.

Reference Books:

i. Protective Relaying Vol-II Warrington, Springer.
ii. Art & Science of Protective Relaying - C R Mason, Willey.
iii. Power System Stability KimbarkVol-II, Willey.
iv. Electrical Power System Protection –C.Christopoulos and A.Wright- Springer
v. Protection & Switchgear –Bhavesh Bhalaja, R.PMaheshwari, NileshG.Chothani-Oxford publisher

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-1: POWER SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
POWER SYSTEM RELIABILITY				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. different distribution functions of basic probability
ii. basics of network modelling and reliability.
iii. understanding of Markov chains.
iv. basic understanding of Reliability analysis of generation systems.
v. applications of Decomposition techniques

UNIT – I:
Basic probability theory – rules for combining probabilities of events – Bernoulli`s trials – probability density and distribution functions – binomial- distributions – expected value and standard deviation of binomial distribution.

UNIT – II:
Network Modelling and Reliability Analysis of Series, Parallel, Series-Parallel networks – complex networks – decomposition method Reliability functions F(t), R(t), h(t) and their relationship – exponential distributions – Expected value and standard deviation of exponential distribution – Bath tub curve – reliability analysis of series parallel networks using exponential distribution – reliability measures MTTF, MTTR, MTBF

UNIT – III:
Markov chains – concept of stochastic transitional probability Matrix, Evaluation of limiting state Probabilities – Markov processes one component repairable system – time dependent probability evaluation using Laplace transform approach – evaluation of limiting state probabilities using STPM – two component repairable models – Frequency and duration concept – Evaluation of frequency of encountering state, mean cycle time, for one, two component repairable models –evaluation of cumulative probability and cumulative frequency of encountering merged states

UNIT – IV:
Generation system reliability analysis – reliability model of a generation system – recursive relation for unit addition and removal – load modelling – merging of generation load model – evaluation of transition rates for merged state model – cumulative Probability, cumulative frequency of failure evaluation – LOLP, LOLE.

UNIT – V:
Composite system reliability analysis decomposition method – distribution system reliability analysis – radial networks – weather effects on transmission lines – Evaluation of load and energy indices.

Course Outcomes:

The student should be able to

i. apply distribution functions of basic probability
ii. know about the reliability analysis applied to power systems.
iii. Markov Chains and application to power systems.
iv. Perform stability analysis of generation systems.
v. decomposition techniques applied to power system.

Reference Books:

i. Reliability Evaluation of Engg. System – R.Billinton, R.N.Allan, Plenum Press, New York.
ii. Reliability Modeling in Electric Power Systems - J. Endrenyi, John Wiley, 1978, Newyork.
iii. An Introduction to Realiability and Maintainability Engineering. Sharies E Ebeling, TATA McGraw Hill – Edition

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-1: POWER SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
POWER SYSTEMS DYNAMICS AND STABILTY				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. model of synchronous machines.
ii. stability studies of synchronous machines.
iii. solution method of transient stability.
iv. different effects of stability on power system
v. effect of different excitation systems.

UNIT – I: System Dynamics:
Synchronous machine model in state space from computer representation for excitation and governor system – modelling of loads and induction machines.

UNIT – II: Steady state stability:
Steady state stability limit – Dynamics Stability limit – Dynamic stability analysis – State space representation of synchronous machine connected to infinite bus-time response – Stability by eigen value approach.

UNIT – III: Digital Simulation of Transient Stability:
Swing equation machine equations – Representation of loads – Alternate cycle solution method – Direct method of solution – Solution Techniques: Modified Euler method – Runge Kutta method – Concept of multi machine stability.

UNIT – IV: Effects on Stability
Effect of governor action and excite on power system stability effect of saturation, saliency & automatic voltage regulators on stability.

UNIT – V: Excitation Systems
Rotating Self-excited Exciter with direct acting Rheostatic type voltage regulator – Rotating main and Pilot Exciters with Indirect Acting Rheostatic Type Voltage Regulator – Rotating Main Exciter, Rotating Amplifier and Static Voltage Regulator – Static excitation scheme – Brushless excitation system.

Course Outcomes:
The student should be able to

i. determine the model of synchronous machines.
ii. know the stability studies of synchronous machines.
iii. get the knowledge of solution methods of transient stability.
iv. analyze the different effects of power system
v. know the effect of different excitation systems in power systems.

Text Books:

i. Power System Stability by Kimbark Vol. I&II, III, Willey.
ii. Power System control and stability by Anderson and Fund, IEEE Press.

Reference Books:

i. Power systems stability and control by PRABHA KUNDUR, TMH.
ii. Computer Applications to Power Systems–Glenn.W.Stagg & Ahmed. H.El.Abiad, TMH.
iii. Computer Applications to Power Systems – M.A.Pai, TMH.
iv. Power Systems Analysis & Stability – S.S.Vadhera Khanna Publishers

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POOL-1: POWER SYSTEMS	L	T	P	C
	4	0	0	4
ECONOMIC OPERATION OF POWER SYSTEM				

Course Objectives:

The objectives of this course is to acquire knowledge on

i. formulate and derive the necessary conditions for economical load scheduling problem.
ii. various constraints, problem formulation and methods to solve the unit commitment problem.
iii. constraints related to hydel power plants, problem formulation and solution techniques for hydro-thermal scheduling problem.
iv. necessity factors governing the frequency control and analyze the uncontrolled and controlled LFC system.
v. basic difference between ELS and OPF problem, formulation of the OPF problem and solution techniques.

UNIT-I: ECONOMIC LOAD SCHEDULING

Characteristics of Steam Turbine, Variations in steam unit characteristics, Economic dispatch with piecewise linear cost functions, Lambda Iterative method, LP method, Economic dispatch under composite generation production cost function, Base point and Participation factors, Thermal system Dispatching with Network losses considered.

UNIT-II: UNIT COMMITMENT

Unit Commitment – Definition – Constraints in Unit Commitment–Unit Commitment solution methods-Priority–List Methods – Dynamic Programming Solution.

UNIT-III: HYDRO THERMAL SCHEDULING

Characteristics of Hydroelectric units, Introduction to Hydrothermal coordination, Long-Range and Short-Range Hydro-Scheduling, Hydroelectric plant models, Hydrothermal scheduling with storage limitations, Dynamic programming solution to hydrothermal scheduling

UNIT-IV: LOAD FREQUENCY CONTROL

Control of generation – models of power system elements – single area and two area block diagrams – generation control with PID controllers – implementation of Automatic Generation control (AGC) –AGC features.

UNIT-V: OPTIMAL POWER FLOW

Introduction to Optimal power flow problem, OPF calculations combining economic dispatch and power flow, OPF using DC power flow, Algorithms for solution of the ACOPF, Optimal Reactive Power Dispatch.

Course Outcomes:

The student should be able to

i. solve the economic load scheduling with and without network losses both in classical method and iterative methods.
ii. solve the unit commitment problem using priority-list method and forwarddynamic method.
iii. solve hydro-thermal scheduling problem for short-term and long-term range.
iv. analyze the single area and two area systems for frequency deviation under sudden change in load.
v. solve the OPF problem using ac and dc load flow methods.

TEXT BOOKS:

i. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003
ii. Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé-Power Generation, Operation and Control-Wiley-Interscience (2013)

REFERENCES:

i. Olle l. Elgerd, "Electric Energy Systems Theory an Introduction", TMH, 2nd Edition, 1983

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POOL-2: POWER ELECTRONICS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
ADVANCED POWER ELECTRONICS				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. classify the resonant converters.
ii. modelling techniques used in dc-dc converters
iii. application of current mode control on converters
iv. role of power electronics and design of closed loop control
v. understand the behavior of semiconductor devices operated as power switches and their protections.

UNIT-I: Resonant Converters:

Introduction, Basic resonant circuit concepts, Classification -Load resonant converters, Resonant switch converters, zero voltage switching clamped voltage converters, Resonant DC link inverters High frequency link integral half cycle converters, Phase modulated resonant converters, Dual active bridge converters, High gain converters.

UNIT-II: Modeling of DC-DC Converters:

Basic ac modeling approach, State space averaging, Circuit averaging and averaged switch modeling, Canonical circuit modeling, Converter transfer functions for buck, boost and buck-boost topologies.

UNIT-III: Current Mode Control:

Introduction, types, advantages and disadvantages, Slope compensation, Determination of duty cycle and transfer functions for buck, boost and buck-boost converters.

UNIT-IV: Design of Closed Loop Control:

Controller Design: Introduction, mechanism of loop stabilization, Shaping E/A gains vs frequency characteristics, Conditional stability in feed-back loop, Stabilizing a continuous mode forward and fly-back converter, Feedback loop stabilization with current mode control, right plane zero.

UNIT-V: Design of Power Converters Components:

Design of magnetic components - design of transformer, design of inductor and current transformer - Selection of filter capacitors, Selection of ratings for devices, input filter design, Thermal design

Course Outcomes:

The students should be able to

i. analyze and design resonant converters
ii. develop power converter models under steady state and small signal conditions
iii. application of current mode control of power converters
iv. design feedback control systems for power converters
v. synthesize and design magnetic components for power converters

Text books:

i. M.H. Rashid: Power Electronics-Circuits, Devices & Applications, Pearson, 4th edition, 2013.
ii. N. Mohan, T.M. Undeland, W.P. Robbins: Power Electronics: Converters, Applications & Design, J.Wiley& Sons, 3rd edition, 2003.

References:

i. Abraham I. Pressman, Keith Billings &Taylor Morey: Switching Power Supply Design, McGraw Hill International, 3rd Edition, 2009.
ii. R.W. Erickson and Dragan Maksimonic: Fundamentals of Power Electronics, Springer, 2nd Edition, 2001.
iii. Umanand, L., Power Electronics: Essentials and Applications, John Wiley India, 1st Edition, 2009.

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POOL-2: POWER ELECTRONICS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
ADVANCED POWER ELECTRONIC CONVERTERS				

Course Objectives:
The objectives of this course is to acquire knowledge

i. to understand the control principle of ac to ac conversion with suitable power semi - conductor devices.
ii. to have the knowledge of ac to dc conversion and different ac to dc converter topologies.
iii. to understand the effect of operation of controlled rectifiers on p.f. and improvement of p.f. with PFC converters
iv. to acquire the knowledge on dc-ac converters and to know the different control techniques of dc-ac converters.
v. to know multilevel inverter configuration to improve the quality of the inverter output voltage.

UNIT– I: OVERVIEW OF SWITCHING DEVICES
Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.

UNIT–II: AC-DC CONVERTERS
Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.

UNIT– III: POWER FACTOR CORRECTION CONVERTERS
Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter

UNIT– IV: PWM INVERTERS:
Principle of operation-Voltage control of single-phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 600PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.

UNIT– V: MULTI LEVEL INVERTERS:

Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters Comparisons of Multilevel Converters.

Course Outcomes:

The student should be able to

i. learn the basic concepts of switching devices.
ii. describe and analyze the operation of AC-DC converters.
iii. analyze the operation of power factor correction converters.
iv. analyze the operation of three phase inverters with PWM control.
v. study the principles of operation of multi- level inverters and their applications.

Text Books:

i. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
ii. Power Electronics: Daniel W. Hart - McGraw-Hill,2011.

Reference Books:

i. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
ii. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.
iii. Power Converter Circuits – William Shepherd & Li Zhang-Yes Dee CRC Press, 2004

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POOL-2: POWER ELECTRONICS	L	T	P	C
	4	0	0	4

POWER QUALITY & CUSTOM POWER DEVICES

Course Objectives:

The objectives of this course is to acquire knowledge on

i. significance of power quality and power quality parameters.
ii. types of transient over voltages and protection of transient voltages.
iii. harmonics, their effects, harmonic indices and harmonic minimizationtechniques.
iv. importance of power devices and their applications.
v. different compensation techniques to minimize power qualitydisturbances.

UNIT– 1

Introduction to power quality: Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.

UNIT– 2

Transient and Long Duration Voltage Variations: Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems.

Principles of Regulating the Voltage, Device for Voltage Regulation, Utility Voltage Regulator Application, Capacitor for Voltage Regulation, End-user Capacitor Application, Regulating Utility Voltage with Distributed generation

UNIT– 3

Harmonic Distortion and solutions: Voltage vs. Current Distortion, Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics, Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics

UNIT– 4

Custom Power Devices: Custom power and custom power devices, voltage source inverters, reactive power and harmonic compensation devices, compensation of voltage interruptions and current interruptions, static series and shunt compensators, compensation in distribution systems, interaction with distribution equipment, installation considerations.

UNIT– 5

Application of custom power devices in power systems: Static and hybrid Source Transfer Switches, Solid state current limiter - Solid state breaker. P-Q theory – Control of P and Q, Dynamic Voltage Restorer (DVR): Operation and control – Interline Power Flow Controller (IPFC): Operation and controlof Unified Power Quality Conditioner (UPQC); Generalized power quality conditioner

Course Outcomes:

The students should be able to

i. identify the issues related to power quality in power systems.
ii. address the problems of transient and long duration voltage variations in power systems.
iii. analyze the effects of harmonics and study of different mitigation techniques.
iv. identify the importance of custom power devices and their applications.
v. acquire knowledge on different compensation techniques to minimize power qualitydisturbances.

Text Books:

i. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
ii. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
iii. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.
iv. Custom Power Devices - An Introduction, Arindam Ghosh and Gerard Ledwich, Springer, 2002

Reference Books:

i. Power Quality Primer, Kennedy B W, First Edition, McGraw-Hill, 2000.
ii. Power System Harmonics, Arrillaga J and Watson N R, Second Edition, John Wiley & Sons,2003.
iii. Electric Power Quality control Techniques, W. E. Kazibwe and M. H. Sendaula, Van Nostrad Reinhold, New York.
iv. Power Quality c.shankaran, CRC Press, 2001
v. Harmonics and Power Systems –Franciso C.DE LA Rosa-CRC Press (Taylor & Francis).
vi. Power Quality in Power systems and Electrical Machines-EwaldF.fuchs, Mohammad A.S. Masoum-Elsevier
vii. Power Quality, C. Shankaran, CRC Press, 2001
viii. Instantaneous Power Theory and Application to Power Conditioning, H. Akagiet.al., IEEE Press, 2007.
ix. A Review of Compensating Type Custom Power Devices for Power Quality Improvement, Yash Pal et.al., Joint International Conference on Power System Technology and IEEE Power India Conference, 2008. POWERCON 2008.
x. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000

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POOL-2: POWER ELECTRONICS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
AUTOMOTIVE POWER ELECTRONICS				

Course Objectives:

The objectives of this course is to acquire knowledge on

vi. various automotive power semiconductor devices.
vii. applications of diodes and analysis of uncontrolled rectifiers.
viii. applications of thyristors and analysis of controlled rectifiers.
ix. analysis of three-phase boost type rectifiers under unbalanced Operating conditions.
x. Power electronic components and their control for Hybrid and Fuel Cell Vehicles.

UNIT-I: Automotive Semiconductor Devices: Introduction, Diodes-The Rectification, Freewheeling, and Clamping Devices, Rectifier Diodes, Freewheeling Diodes, Zener Diodes, Schottky Diode. Power MOSFETs-The Low Voltage Load Drivers, MOSFET Basics, MOSFET Characteristics, IGBTs-The High Voltage Power Switches, IGBT Basics, IGBT Power Modules, Ignition IGBT, Power Integrated Circuits and Smart Power Devices.

UNIT-II: Diode Rectifiers: Analysis of Three-Phase Full-Bridge Diode Rectifier Circuit without & with Input Inductors and DC-Link Capacitor, Commutation Analysis Considering Effect of the Input Inductance, Analysis of Input Phase Current and Output Current of Diode Rectifier, Calculation of DC-Link Power, Calculations of DC-Link Capacitor According to Various Load Conditions, Case of Continuous Full Load Condition, Case of Overload Condition, Case of Motor Accelerating Condition.

UNIT-III: Thyristor Rectifier: Topology and Operation Modes, Fire Angle control Scheme, Linear Fire Angle Control Scheme, Cosine Wave Crossing Scheme, PLL Scheme, Analysis of Three-Phase Full-Bridge Thyristor Rectifier, Equivalent Circuit and Output Voltage, Influence of Input Inductance , Selection of Input Inductance.

UNIT– IV: Unbalanced Operation of Three-Phase Boost Type Rectifiers: Analysis of the PWM Boost Type Rectifier under Unbalanced Operating Conditions , Harmonic Reduction in the PWM Boost Type Rectifier under Unbalanced Operating Conditions, Control Methods for Input/Output Harmonic Elimination of the PWM Boost Type Rectifiers under Unbalanced Operating Conditions , Control Method for Input/Output Harmonic Elimination of the PWM Boost Type Rectifier under Unbalanced InputVoltages and Unbalanced Input Impedances.

UNIT– V: Power Electronics and Control for Hybrid and Fuel Cell Vehicles: Introduction, Hybrid Electric Vehicles, Series Hybrid Vehicle Propulsion System, Parallel Hybrid Vehicle Propulsion System, Fuel Cell Vehicles, Fuel Cell Vehicle Propulsion System, Fuel Cell Vehicle Propulsion System Considerations, Power Electronics Requirements,
Propulsion Motor Control Strategies, Slip Frequency Control, Vector Control of Propulsion Motor, APU Control System in Series Hybrid Vehicles.

Course Outcomes:

The students should be able to

vi. identify the Various automotive semiconductor devices.
vii. design and analyze the uncontrolled diode rectifiers.
viii. design and analyze the controlled thyristor rectifiers.
ix. operate Three-Phase Boost Type Rectifiers under unbalanced conditions**.**
x. control Hybrid and Fuel Cell Vehicles using Power Electronics components.

Text Books:

iv. Automotive Power Electronics and Motor Drives, ALI EMADI, by CRC Press Taylor &Francis Group, LLC,2005.
v. N. Mohan, T. Undeland, and W. Robbins, Power Electronics: Converters, Applications andDesigns, Wiley, New York, 1989.
vi. R. Jurgen (Ed.), Automotive Electronics Handbook, 2nd Edition, McGraw-Hill, New York,1999.

Reference Books:

vii. J. Kassakian et al., Principle of Power Electronics, John Wiley & Sons, New Yo
viii. N. Mohan et al., Power Electronics, 2nd Ed., John Wiley & Sons, New York, 1995.
ix. K. Ogata, Modern Control Engineering, 2nd Ed., Prentice Hall, Englewood Cliffs, NJ, 1990.
x. A.V. Stankovic and T.A. Lipo. A Generalized Control Method for Input-Output Harmonic Elimination for the PWM Boost Type Rectifier Under Simultaneous Unbalanced Input Voltages and Input Impedances. Proceedings of IEEE PESC, Vancouver, pp. 1309–1314, 2001.
xi. S. Yongsug, V. Tieras, and T.A. Lipo. A Nonlinear Control of the Instantaneous Power in d-q Synchronous Frame for PWM AC/DC Converter Under Generalized Unbalanced Oper- ating Conditions. Conference Record of the 2002 IEEE Industry Applications Conference, Chicago, pp. 1189–1196, 2002.
xii. J. Botti and C. Miller, Powertrains of the Future: Reducing the Impact of Transportation on the Environment, SAE 1999 World Congress, March 1–4, 1999, Detroit, MI.
xiii. J. Walters, H. Husted, and K. Rajashekara, Comparative Study of Hybrid Powertrain Strat- egies, SAE Future Transportation Technology Conference, August 20–22, 2001, Costa Mesa,CA.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-3: CONTROL SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
MODERN CONTROL SYSTEMS				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. representation of State Space System.
ii. time response on linear systems.
iii. concept of controllability and observability.
iv. stability of linear and non-linear systems
v. different aspects related to design of optimal control system.

UNIT I: System representation:

Introduction to state and state variables - system representation in state variable form - transformations - Phase variable form - Canonical forms – Physical systems - Plant models –Representation using state function - Lagrange linearization

UNIT II: Time response:

State transition matrix – Properties and methods of valuation - Time response of linear systems -State diagrams - Resolvant matrix - Resolvant algorithm

UNIT III: Controllability and observability:

Definition and concepts - Criteria for controllability and observability - State variable feedback -Pole placement - Luenberg observer design

UNIT IV: Stability:

Introduction - definition of stability - stability in the sense of Lyapunov - stability of linear systems - transient response - Behavior of estimation - stability of non linear systems - generation of Lyapunov functions

UNIT V: Optimal control:

Formulation of the optimal control problem - method of calculus of variations - use of Hamiltonian method - Pontryagin's minimum principle - Optimal control problem - Hamilton –Jacobi approach - Continuous time linear state regulator matrix riccati equation - Methods of solution – State variable feedback design

Course Outcomes:
The students should be able to:

i. develop mathematical models of physical systems
ii. analyze the time response of linear systems
iii. apply the concept of controllability and observability
iv. analyze the issues related to the stability of automatic control systems.
v. design optimal controllers for physical systems including power electronic and power systems.

Text Books:

i. M. Gopal: Modern Control Systems Theory, Wiley Eastern Limited, New Delhi, 2005
ii. Katsuhiko Ogata: Modern control Engineering, Prentice-Hall of India, 2010
iii. B.C.Kuo, Automatic control systems'(5th Edition), Prentice Hall of India, 1988.

Reference Books:

i. Hadi Saadat, "Computational Aids in Control System Using MATLAB", McGraw Hill International
ii. Ogata K., "Modern Control Engineering", 4th Edition, Prentice Hall
iii. Norman S. Nise, "Control Systems Engineering", 3rd Edition, Wiley

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POOL-3: CONTROL SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
DISCRETE DATA CONTROL SYSTEMS				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. elements of estimation for a dynamic model
ii. analysis of parameter estimation for large scale systems
iii. model reduction techniques and error minimization
iv. simplification using frequency domain techniques
v. analysis of block-diagonalization of continuous systems

UNIT – I: Modelling and parameter estimation

Introduction to probability theory, elements of estimation theory, application to parameter estimation for a dynamical model, some methods for the determination of transfer functions.

UNIT – II: Parameter estimation for large scale systems

Hierarchical parameter estimation, the multiple projection approach, recursive algorithm for the minimum variance estimator Aggregation of control systems, problem statement, properties of the aggregated system matrix, determination of the Aggregation matrix; Generation of feedback controls: linear dynamic optimization, bounds on sub optimality, eigenvalue assignment.

UNIT – III: Model reduction techniques

Model analysis approach, mathematical development, three basic methods, and a general approach. Subspace projection methods, projection error minimization, and derivation of reduced model. Optimal order reduction, problem formulation, conditions of optimality, numerical algorithm, polynomial input functions. A comparative study. Extension to discrete systems, preliminary analysis, two model reduction techniques, output error minimization. Examples.

UNIT-IV Model simplification using frequency domain techniques

Simplification by continued function expansions: three Cauer forms, a generalized Routh algorithm, simplified models, relationship to aggregation, and extension to discrete models; Approximation methods for simplification: time moment matching, Padetype approximations, Routh-Hurwitz method. Minimal realization algorithms: conditions of reliability, Pade - type realizable models, aggregated model of Routh approximants

UNIT–V: Scale Analysis Block-Diagonalization of Continuous Systems

Problem statement, numerical algorithms, basic properties, relation to model aggregation. Feedback control design: two stage eigenvalue placements. Decoupling of discrete systems:, state feedback design.

Text Books:

i. Magdi S. Mahmoud and Madan G. Singh – "Large scale systems modeling", Pergamon press, Oxford.
ii. Lan Lunze – "Feedback control of Large scale system s", Prentice Hall International, NewYork.

Reference Books:

i. Magdi S. Mahmoud, Mohamed F. Hassan, Mohamed G. Darwish- "Large scale control systems - Theories and Techniques", Marcel Dekkar, Inc, New Y ork and Basel.
ii. Andrew P. Sage, "Methodology for large-scale systems", McGraw-Hill, 1977
iii. Efficient Modeling and Control of Large-Scale Systems, edited by Javad Mohammad pour, and Karolos M., Springer, 2010.

Course Outcomes:

The students should be able to:

i. apply estimation for a dynamic model in large scale systems
ii. analyse parameter estimation for large scale systems
iii. design model reduction techniques and error minimization
iv. analyse large scale systems using frequency domain techniques
v. design block-diagonalization of continuous systems

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POOL-3: CONTROL SYSTEMS	L	T	P	C
	4	0	0	4
PROCESS DYNAMICS AND CONTROL				

Course Objectives:

The objectives of this course is to acquire knowledge on

i classification and understand process control.
ii dynamic behaviours and responses of different processes.
iii feedback controllers and responses of control system instrumentation.
iv design and analysis of dynamic system.
v design and different configurations of feedforward and ratio control.

UNIT-I

INTRODUCTION TO PROCESS CONTROL

Representative Process Control Problems, illustrative Example—A Blending Process, Classification of Process Control Strategies, A More Complicated Example—A Distillation Column, The Hierarchy of Process Control Activities, An Overview of Control System Design

UNIT-II

DYNAMIC BEHAVIOR OF PROCESSES

Laplace Transforms, Transfer Function Models, Properties of Transfer Functions, Linearization of Nonlinear Models, Dynamic Behaviours of First-Order and Second-Order Processes, Standard Process Inputs, Response of First-Order Processes, Response of Integrating Processes, Response of Second-Order Processes,

UNIT-III

FEEDBACK CONTROLLERS AND CONTROL SYSTEM INSTRUMENTATION

Introduction, Basic Control Modes, Features of PID Controllers, Digital Versions of PID Controllers, Typical Responses of Feedback Control Systems, On–Off Controllers, Sensors, Transmitters, and Transducers, Final Control Elements, Accuracy in Instrumentation.

UNIT-IV

DYNAMIC BEHAVIOUR AND STABILITY OF CLOSED-LOOP CONTROL SYSTEMS

Block Diagram Representation, Closed-Loop Transfer Functions, Closed-Loop Responses of Simple Control Systems, Stability of Closed-Loop Control Systems, Root Locus Diagrams

Frequency Response Analysis and Control System Design

Sinusoidal Forcing of a First-Order Process, Sinusoidal Forcing of an nth-Order Process, Bode Diagrams, Frequency Response Characteristics of Feedback Controllers, Bode Stability Criterion, Gain and Phase Margins

UNIT-V

FEEDFORWARD AND RATIO CONTROL

Introduction to Feedforward Control, Ratio Control, Feed forward Controller Design Based on Steady-State Models, Feedforward Controller Design Based on Dynamic Models, The Relationship Between the Steady-State and Dynamic Design Methods, Configurations for Feedforward–Feedback Control, Tuning Feedforward Controllers.

Course Outcomes:

The students should be able to:

i understand process control.
ii Responses and behaviour of the system.
iii understand the PID controllers and response of feedback system.
iv Analyse closed loop system.
v Design the feedforward controller for dynamic models.

Text Books:

i. Process Dynamics and Control, 2nd Edition By Dale E. Seborg, Thomas F. Edgar, and Duncan A. Mellichamp, Wiley, Hoboken, NJ, 2003, 736 pp.,

ii. Coughnaowr, D. R., "Process Systems Analysis and Control", McGraw-Hill, Inc.
iii. Stephanopolous, G., "Chemical Process Control", Prentice-Hall.

Reference

i. P. Harriott, Process Control, Tata McGraw-Hill Publishing Co., Ltd.,New Delhi, 1984.
ii. A. Pollard, Process Control, Heinemann Educational Books, London,1981.
iii. T. Webber, An Introduction to Process Dynamics and Control, JohnWiley & Sons, New York, 1973.
iv. B.G. Liptak, Instrumentation in Processing Industries, Vol. II, Chilton Book Co., 1973.
v. Bequette, B. W., "Process Control: Modeling, Design, and Simulation", Prentice-Hall, Inc.
vi. Chidambaram, M., "Computer Control of Processes" Narosa Publishing House Pvt. Ltd., Ind.
vii. D.C. Sikdar," Instrumentation and Process Control", Khanna Book Publishing

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POOL-3: CONTROL SYSTEMS	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
OPTIMAL CONTROL THEORY				

Course Objectives:
The objectives of this course is to acquire knowledge on

i. representation of state space system performance measures
ii. formulation of optimal control problem and linear regulator problems
iii. fundamentals and applications of calculus of variations
iv. optimal problems conditions and regulator problems
v. applications of different numerical techniques of optimal controls

UNIT-I: Introduction:

Problem formulation- State variable representation of systems – Performance measures for optimal control problems – selecting a performance measure.

UNIT-II: Dynamic programming:

The optimal control law - principle of optimality and its application - optimal control system - interpolation - recurrence relation of dynamic programming-computational procedure for solving optimal control problems – characteristics of dynamic programming solution-analytical results-discrete linear regulator problems-Hamilton- Jacobi-Bellman equation-continuous linear regulator problems, Riccati Equation

UNIT-III: Calculus of varients:

Fundamental concepts- linearity of functional-closeness of functions-the increment of a functional-The variation of a functional- maxima and minima of functional- the fundamental theorem of the calculus of variations - Functional of a single function- the simplest variational problem

UNIT-IV: Optimal control problems:

Necessary conditions for optimal control - Linear regulator problem-Pontryagin's minimum principle and state inequality constraints.

UNIT-V: Iterative numerical techniques for finding optimal controls:

Two-point boundary-value problems-The method of steepest descent-Features of the steepest descent algorithm.

Course Outcomes:

The students should be able to:

i apply state space analysis and optimal control problems.
ii analyses the applications of dynamic programming and linear regulator problems.
iii apply the calculus functional concepts to the system.
iv assess the optimal control problems.
v Apply different numerical techniques for optimal control problems.

Text Books:

i. Optimal control theory-An Introduction by Donald E.Kirk - Prentice Hall Networks series.
ii. M. Gopal: Modern Control Systems Theory, Wiley Eastern Limited, New Delhi, 2005

Reference Books:

i. Katsuhiko Ogata: Modern control Engineering, Prentice-Hall of India, 2010
ii. B.C.Kuo, Automatic control systems'(5th Edition), Prentice Hall of India, 1988.

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POOL-4: ELECTRICAL MACHINES	L	T	P	C
	4	0	0	4
ADVANCED ELECTRICAL MACHINES				

Course Objectives:

The objective of this course is to acquire knowledge to

i. operating principles, characteristics of permanent magnet materials.
ii. constructional and operational aspects of permanent magnet brushless machines.
iii. features and make use of performance and control strategies of stepper motors.
iv. make use of performance and control strategies of reluctance machines.
v. select and suggest appropriate synchronous reluctance machine based on application.

UNIT - I: Permanent Magnet Materials

Types, properties and characteristics of permanent magnets, features of permanent magnet excitation, magnetic circuit model, sintered permanent magnet and bonded permanent magnet materials , effect of temperature, handling of permanent magnets

UNIT - II: Permanent Magnet Brushless Motors

Construction, operating principle & features of permanent magnet brushless(PMBL)motors, various types of PMBL motors, magnetic circuit model, armature reaction ,derivation of emf and torque equation, types of emf generated, performance characteristics ,closed loop control of PMBL motors, sensor less control of PMBL motors, case studies considering applications viz. electric vehicle, marine propulsion & PV fed water ping, advancements in topologies and reviews, applications of PMSG in various energy conversion systems.

UNIT - III: Stepper Motors

Concept of Stepper Motors, types and operating principle of stepper motors, static and dynamic characteristics of stepper motors, stepper motor converters

UNIT - IV: Switched Reluctance Motors:

Construction and operating principle and features of switched reluctance motors (SRM), equivalent circuit, inductance profile, derivation of torque equation and factors affecting torque, performance characteristics, control of SRM, various types of converters, closed loop control of SRM, sensor less control of SRM, case studies considering applications viz. electric vehicle, washing machine

UNIT-V: Synchronous Reluctance Motors

Construction, operating, principle, features, equivalent circuit, vector diagram, control and topological advancements of synchronous reluctance motors, case studies considering Applications viz. electric vehicle, water pumping and etc

Course Outcomes:

The students should be able to

i. interpret properties and characteristics of permanent magnet materials.
ii. analyze constructional and operational aspects of reluctance machines.
iii. examine and make use of performance and control strategies of permanent magnet brushless machines
iv. examine and make use of performance and control strategies of reluctance machines
v. selection and suggest appropriate machine based on application requirements

Text books:

i. MillerT.J.E., BrushlessPermanentMagnetandReluctanceMotorDrives,ClarendonPress
ii. V.V.Athani,"StepperMotors:Fundamentals,ApplicationsandDesign",NewAgeInternational Pvt.Ltd.

Reference Books:

i. R.Krishnan, Permanent Magnet Synchronou sand Brushless DC Motor Drives ,CRC Press
ii. Venkatratnam K.,Special Electric Machines, CRC Press.
iii. Recent papers from IEEE transactions and reputed journals

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-4: ELECTRICAL MACHINES	L	T	P	C
	4	0	0	4
SPECIAL ELECTRIC MACHINES				

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. properties of magnetic materials and the operation of PMDC motors.
ii. performance and control of stepper motors and their applications.
iii. theory of operation and control of switched reluctance motor.
iv. characteristics and performance of PM BLDC motors.
v. principle of operation of linear induction motor.

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-Temperature effects: reversible and irreversible losses-high temperature effects-reversible losses-Irreversible losses recoverable by magnetization-Mechanical properties, handling and magnetization-Application of permanent magnets in motors-power density-operating temperature range-severity of operation duty.

UNIT - II: Stepper Motors

Classification of stepper motors – Hybrid and Variable Reluctance Motor (VRM) - Construction and principle of hybrid type synchronous stepper motor – Different configuration for switching the phase windings control circuits for stepper motors – Open loop and closed loop control of 2-phase hybrid stepping motor. Construction and principle of operation of Variable Reluctance Motor (VRM) – Single stack and multiple stack – Open loop control of 3- phase VR Stepper Motor- Applications.

UNIT - III: Switched Reluctance Motors

Construction – 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.

UNIT - IV: Permanent Magnet Brushless DC Motor

Types of constructions – Surface mounted and interior type permanent magnet – Principle of operation of BLDC motor. Torque and EMF equations of square permanent magnet brushless motor – Torque speed characteristics – Performance and efficiency- Square wave brushless motors with 120^0 and 180^0 magnetic areas commutation.

Torque and EMF equations of sine wave permanent magnet brushless motor – Phasor Diagram – Circle diagram – Torque/speed characteristics – Comparison between square wave and sine wave permanent magnet motors - 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.

Course Outcomes:

The students should be able to:

i. acquire knowledge on the characteristics and application of PMDC motors.
ii. explore different types, construction and principle of operation of different types of stepper motors and their applications.
iii. explain theory of operation of switched reluctance motor and its control.
iv. analyse the performance of PMBLDC motors.
v. explain the operation of linear induction motor drive for traction purpose.

Text Books:

i. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller, 1989, Oxford.
ii. Special electrical Machines, K.VenkataRatnam, University press, 2009, New Delhi.

Reference Books:

i. Special electrical machines, E.G. Janardhanan, PHI learning private limited, 2014.

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POOL-4: ELECTRICAL MACHINES	L	T	P	C
	4	0	0	4
UNIFIED THEORY OF ELECTRICAL MACHINES				

Course Objectives:

The objective of this course is to acquire knowledge to

i. operating principles of electrical machines.
ii. concept of transformation and applications of electrical machines.
iii. modeling and analysis of poly phase induction and synchronous machines.
iv. dynamic analysis of interconnected machines.
v. linearized machine equations for poly phase induction and synchronous machines.

UNIT - I:

Introduction: Introduction to the theory of basic two pole machine applicable to DC machines, 3-ph induction machines and synchronous machine. Kron's primitive Machine. Need of modeling, Introduction to modeling of electrical machines, voltage and torque equations

UNIT - II:

Concept of Transformation: Change of variables & Machine variables and transform variables for arbitrary reference frames. Application to D.C. machine for steady state and transient analysis, and equation of cross field commutator machine, linear transformation from 3-phase to 2-phase - transformation from rotating axes to stationary axes - power invariance - park's transformation for 3-phase synchronous and induction machines...

UNIT - III:

Poly phase Induction Machines & Synchronous Machines: Voltage, torque equations, Equivalent circuit, Steady state analysis, Dynamic performance during sudden changes in load torque and three phase faults at the machine terminals.

Poly phase Synchronous Machine: Voltage and Torque Equations in stator, rotor and air-gap field reference frames. Transformation and Transformed Equations. Parks Transformation Voltage and power equation for salient and non-salient machines, their phasor diagrams, simplified equations of a synchronous machine with two damper coils

UNIT - IV:

Dynamic Analysis of Interconnected Machines: Machine Interconnection Matrices. Transformation of Voltage and Torque Equations using Interconnection Matrix. Large Signal Transient Analysis using Transformed Equations.

UNIT-V: Linearized Machine Equations:

Linearization of machine equations. Small displacement stability: Eigen values, Eigen values of typical induction machine and synchronous machine, Transfer Function Formulation.

Course Outcomes:

The students should be able to

i. understand the principles and modeling of electrical machines.
ii. concept of transformation and applications of poly phase induction and synchronous machines.
iii. performance and analysis of poly phase induction and synchronous machines.
iv. understand the dynamic analysis of interconnected machines.
v. understand the analysis and linearized machine equations for poly phase induction and synchronous machines.

Text books:

i. P.C. Krause, Analysis of Electric Machinery, Wiley publication.
ii. B. Adkins, The General theory of Electrical Machines, Chapman & Hall publication.
iii. P.S. Bhimbra, Generalized theory of Electrical machines, Khanna publisher.

Reference Books:

i. B. Adkins & R.G. Harley, The General theory of AC Machines, Springer Natherland
ii. Boldia & S.A. Nasar, Electrical Machine Dynamics, The Macmillan Press Ltd.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-4: ELECTRICAL MACHINES	L	T	P	C
	4	0	0	4
ADVANCED ELECTRIC DRIVES				

Course Objectives:

The Objectives of this course to acquire knowledge on

i. characteristics and control of induction motors.
ii. operation of VSI and CSI fed AC Drives.
iii. operation of the speed control of induction motor drive from the rotor side.
iv. field oriented control of induction machines.
v. operation of synchronous motor drives.

UNIT I: STATOR VOLTAGE CONTROLLED INDUCTION MOTORS

Introduction - Rotating magnetic field – torque production, Equivalent circuit– Steady state performance equations, Variable voltage constant frequency operation - Conventional method - Variable voltage characteristics –- Control of induction motor by AC voltage controllers - Waveforms - speed torque characteristics - Four quadrant operation – Closed loop speed control - different braking methods.

UNIT II: STATOR FREQUENCY CONTROLLED INDUCTION MOTORS

Constant voltage variable frequency operation - constant Volt/Hz operation - speed torque characteristics, Analysis -Drive operating regions, variable stator current operation and analysis, six step inverter voltage and frequency control - PWM inverter fed induction motor drives - CSI fed IM variable frequency drives - comparison - Closed loop speed control

UNIT III: ROTOR CONTROLLED INDUCTION MOTOR DRIVES

Review of rotor resistance control – Static rotor resistance control – Performance Analysis, Speed torque characteristics –Slip power recovery scheme - Conventional method, Static Kramer drives, Static Scherbius drives, Analysis

UNIT IV: FIELD ORIENTED CONTROL

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy

UNIT V: SYNCHRONOUS MOTOR DRIVES

Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation Power factor control and V curves – starting and braking of Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – voltage source inverter drive with open loop control – self-controlled and separate controlled synchronous motor – self-controlled synchronous motor drive using load commutated thyristor inverter – Cycloconverter fed drive

Course Outcomes:

Student should be able to

i. analyze the performance of stator voltage-controlled inductance motor drive.
ii. assess the operation of VSI & CSI fed induction motor speed control.
iii. analyze the speed control of induction motor drive from the rotor side.
iv. describe the field-oriented control of induction machine.
v. analyze the control of synchronous motor drives.

Text Books:

i. Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education 2002.
ii. N. Mohan, Power Electronics- Converters, Applications and Design, 3rd Ed., John Wiley & Sons, 2003.

Reference Book:

i. Vedam Subramanyam, "Electric Drives – Concepts and Applications", McGraw Hill, Second Edition, 2010.
ii. Gobal K.Dubey, "Fundamentals of Electrical Drives", Narosal Publishing House, New Delhi, Second Edition ,2009
iii. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.
iv. M. Rashid, Power Electronics- Circuits, Devices and Applications, 3rd Ed., Prentice Hall, 2004.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-5: RENEWABLE ENERGY TECHNOLOGY	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
DISTRIBUTED GENERATION & MICRO GRIDS				

Course Objectives:
The objectives of this course to acquire knowledge on

i. fundamental concept of distributed generation

ii. describe the impact of grid integration.

iii. optimal size, placement of distributed generation

iv. different control aspects of DG's

v. concept of micro grid and its configuration

UNIT – I: Need for Distributed Generation
Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

UNIT – II: Grid integration of DGs
Different types of interfaces – Inverter based DGs and rotating machine-based interfaces – Aggregation of multiple DG units – Energy storage elements – Batteries, ultracapacitors, flywheels.

UNIT – III: Technical impacts of DGs
Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems.

UNIT-IV: Economic and control aspects of DGs
Market facts, issues and challenges – Limitations of DGs – Voltage control techniques, Reactive power control, Harmonics, Power quality issues – Reliability of DG based systems – Steady state and Dynamic analysis.

UNIT – V: Introduction to micro-grids
Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids – Modeling & analysis – Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units – Transients in micro-grids – Protection of micro-grids – Case studies.

Course Outcomes:
The students should be able to:

i. find the size and optimal placement DG
ii. analyze the impact of grid integration and control aspects of DG's.
iii. analyze the operational issues of the DG's to be connected in the system.
iv. describe the technical impacts of DG's in power systems.
v. analyze a micro grid and modelling of it.

Text Books:

i. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.

ii. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.

iii. Nikos Hatziargyriou , Microgrids: Architectures and Control (Wiley - IEEE), 2014.

Reference Books:

i. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.

ii. K.Venkatanagaraju,M. Biswal ,'Microgrid: Operation, Control, Monitoring and Protection' , Monalisa (Eds.),2020

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POOL-5: RENEWABLE ENERGY TECHNOLOGY	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
SMART GRID TECHNOLOGIES				

Course Objectives:
The objective of this course is to acquire knowledge:

i. To group various aspects of the smart grid.
ii. To defend smart grid design to meet the needs of a utility.
iii. To select issues and challenges that remain to be solved.
iv. To analyze basics of electricity, electricity generation, economics of supply and demand.
v. To analyze various aspects of electricity market operations in both regulated andderegulated environment.

UNIT - I: Introduction to Smart Grid & Evolving it to a Perfect Power System:
Introduction: Introduction to smart grid- Electricity network-Local energy networks- Electric transportation-Low carbon central generation-Attributes of the smart grid- Alternate views of a smart grid.
Smart Grid to Evolve a Perfect Power System: Introduction- Overview of the perfect power system configurations- Device level power system- Building integrated power systems- Distributed power systems-Fully integrated power system-Nodes of innovation.

UNIT - II: DC Distribution and Smart Grid
AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighbourhood-Potential future work and research.
Intelligrid Architecture for the Smart grid: Introduction- Launching intelligrid- Intelligridtoday- Smart grid vision based on the intelligrid architecture-Barriers and enabling technologies. SCADA, synchro phasors (WAMS)

UNIT – III: Dynamic Energy Systems Concept
Smart energy efficient end use devices-Smart distributed energy resources-Advanced whole building control systems- Integrated communications architecture-Energy management-Role of technology in demand response-Current limitations to dynamic energy management-
Distributed energy resources-Overview of a dynamic energy management-Key characteristics of smart devices-Key characteristics of advanced whole building control systems-Key characteristics of dynamic energy management system.

UNIT - IV: Energy Port as a Part of The Smart Grid & Market Implementation
Energy Port As Part Of The Smart Grid: Concept of energy -Port, generic features of the energy port. Policies and Programs to Encourage End – Use Energy Efficiency: Policies and programs in action -multinational -national-state-city and corporate levels.
Market Implementation: Framework-factors influencing customer acceptance and response

- program planning-monitoring and evaluation.

UNIT - V: Efficient Electric End – Use Technology Alternatives

Existing technologies – lighting - Space conditioning - Indoor air quality - Domestic water heating - hyper efficient appliances - Ductless residential heat pumps and air conditioners - Variable refrigerant flow air conditioning-Heat pump water heating - Hyper efficient residential appliances - Data center energy efficiency-LED street and area lighting - Industrial motors and drives - Equipment retrofit and replacement - Process heating - Cogeneration, Thermal energy storage - Industrial energy management programs - Manufacturing process-Electro-technologies, Residential, Commercial and industrial sectors.

Course Outcomes:

The students should be able to:

i. recite the structure of an electricity market in either regulated or deregulated market conditions.
ii. understands the advantages of DC distribution and developing technologies in distribution.
iii. discriminate the trade-off between economics and reliability of an electric power system, differentiate various investment options
iv. analyze the development of smart domestic system.
v. analyze the development of intelligent domestic system.

Text Books:

i The Smart Grid, Enabling Energy Efficiency and Demand SideResponse, Clark W Gellings, CRC Press, 2009
ii Smart Grids, Jean Claude Sabonnadiere, Nouredine Hadjsaid, Wiley-ISTE, IEEEPress, May 2012.
iii SMART GRID Fundamentals of Design and Analysis, James Momoh, IEEE press, A John Wiley & Sons, Inc., Publication.

Reference Books:

i Smart Grid: Technology and Applications, Janaka Ekanayake, Kithsiri Liyanage, Jianzhong.Wu, Akihiko Yokoyama, NickJenkins, Wiley, 2012.
ii Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEEPress, 2012.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-5: RENEWABLE ENERGY TECHNOLOGY	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
GRID INTEGRATION OF RENEWABLE ENERGY SYSTEMS				

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. operation and control on the issues related to the integration of distributed renewable generation into the network.
ii. power system equipment's used for integration.
iii. power quality and its management along with approaches for grid stabilization.
iv. interpret grid stabilization scheduling and dispatch
v. deep understanding about integration techniques for RE sources.

UNIT-I: Introduction

Various techniques of utilizing power from renewable energy sources, concept of nano/micro/mini grid. Need of integrating large renewable energy sources, issues related to integration of large renewable energy sources, rooftop plants. Concept of VPP.

UNIT-II: Power system equipments for grid integration Synchronous generator: synchronization/integration to existing grid, load sharing during parallel operation, stability (swing equation and solution) Induction Generator: working principle, classification, stability due to variable speed and counter measures Power Electronics: need of power electronic equipments in grid integration, converter, inverter, chopper, ac regulator and cyclo converters for AC/DC conversion.

UNIT-III Power quality and management:

THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, system protection, grid codes.

UNIT-IV Grid stabilization: Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems, electric vehicles Ancillary services in Indian Electricity Market (regulatory aspect), CERC and CEA orders (technical and safety standards)

UNIT – V: Integration of alternate sources of energy:

Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Course Outcomes:

The students should be able to:

i. explain operation and control on the issues related to the integration of distributed renewable generation into the network.
ii. analysis of stability in power system integration using synchronous generators and induction generators.
iii. determine challenges and issues in integration of renewable sources
iv. interpret the load scheduling and dispatch
v. analysis of ac and dc integration techniques for multiple resources.

Text Book:

i Integration of Alternative sources of Energy, Felix A. Farret and M. Godoy Simoes, IEEE Press – Wiley-Interscience publication, 2006.
ii Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, CRC Press (Taylor & Francis group), 2017
iii Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009.
iv Wind Power Integration connection and system operational aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson and D. Milborrow, IET Power and Energy Series 50 (IET digital library), 2007

Reference Books:

i. Power Generation, Operation, and Control, Allen J. Wood, Bruce F. Wollenberg, Gerald B. Sheblé, John Wiley & Sons, New York, 2013 (3rd edition)
ii. Power Electronics: Circuits, Devices, and Applications. M.H.Rashid, Pearson Education India, 2013
iii. Advanced power system analysis and dynamics, L.P.Singh, New age international publishers, 2017

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

POOL-5: RENEWABLE ENERGY TECHNOLOGY	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**
SCADA AND ENERGY MANAGEMENT SYSTEMS				

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. overview of data acquisition system and terms related
ii. control function of SCADA and applications of functions
iii. different communication channels and related terms
iv. data base management systems and network data bases
v. energy management center and load management

UNIT-I: GENERAL THEORY:

Purpose and necessity, general structure, data acquisition, transmission and monitoring, general power system hierarchical structure, overview of the methods of data acquisition systems, commonly acquired data, transducers, RTUs, data concentrators, various communication channels, cables, telephone lines, power line carrier, microwaves, fiber- optical channels and satellites.

UNIT-II: SUPERVISORY AND CONTROL FUNCTIONS:

Data acquisitions, status indications, measured values, energy values, monitoring alarm and event application processing. Control function: ON/OFF control of lines, transformers, capacitors and applications in process industry, valve, opening, closing etc. Regulatory functions: set points and feed-back loops, time tagged data, disturbance data collection and analysis, calculation and report preparation.

UNIT- III: MAN- MACHINE COMMUNICATION:

Operator consoles and VDUs, displays, operator dialogues, alarm and event loggers, mimic diagrams, report and printing facilities.

UNIT-IV: DATA BASES - SCADA, EMS and NETWORK DATA BASES:

SCADA system structure - local system, communication system and central system, Configuration- non-redundant single processor, redundant dual processor, multi control centers, system configuration. Performance considerations, real time operation system requirements, modularization of software programming languages.

UNIT- V: ENERGY MANAGEMENT CENTER

Functions performed at a centralized management center, production control and load management, economic dispatch, distributed centers and power pool management.

Course Outcomes:

The students should be able to:

i. analyze the general terms related to SCADA.
ii. apply the Supervisory and control functions.
iii. know the different communication modes and functions.
iv. configure the data bases related to SCADA and Networks systems.
v. analyze the load and energy management.

Text Books:

i. Torsten Cegrell, Power System Control Technology, Prentice Hall International, 1986
ii. Stuart A. Boyer, SCADA: Supervisory Control And Data Acquisition, The Instrumentation, Systems and Automation Society, 4th edition, 2009.
iii. Krishna Kant, Computer-Based Industrial Control, PHI Learning,2nd edition, 2013

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA
ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)

Minor Courses

S.No	Subject	L-T-P	Credit
	TRACK-1		
13.	Electrical Circuit Theory	**3-1-0**	**4**
14.	EMF Theory	**3-1-0**	**4**
15.	Control systems	**3-1-0**	**4**
	TRACK-2		
16.	Fundamentals of Electrical Machines	**3-1-0**	**4**
17.	Power Electronics	**3-1-0**	**4**
18.	Electrical Measurements & instrumentation	**3-1-0**	**4**
	TRACK-3		
19.	Electrical power generation & economic concepts	**3-1-0**	**4**
20.	Renewable Energy Sources	**3-1-0**	**4**
21.	Energy Storage Systems	**3-1-0**	**4**
	TRACK-4		
22.	Transmission and Distribution of Electrical Power	**3-1-0**	**4**
23.	Utilization of Electrical Energy	**3-1-0**	**4**
24.	Electrical Safety Course	**3-1-0**	**4**

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL CIRCUIT THEORY	L	T	P	C
	3	1	0	4

Course Objectives:

The objectives of this course is to acquire knowledge on

vi. concepts of passive elements, types of sources and various network reduction techniques and applications of electrical circuits.
vii. behavior of RLC networks for sinusoidal excitations.
viii. 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.
ix. applications of network theorems for analysis of electrical networks.
x. concepts of balanced and unbalanced three-phase circuits

UNIT-I

Introduction to Electrical Circuits

Basic Concepts of active and passive elements and their V-I relations, Sources (dependent and independent), Kirchhoff'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, Super node and Super mesh analysis, Principles of Duality.

UNIT-II

Single Phase A.C Systems

Periodic waveforms (determination of rms, average value, peak factor and form factor), concept of phase angle, phase difference – waveforms and phasor diagrams, lagging and leading networks, rectangular and polar forms of representations, steady state analysis of R, RL and RC circuits, power factor and its significance, real, reactive and apparent power, waveforms of instantaneous power and complex power.

UNIT-III

Analysis of AC Networks

Extension of node and mesh analysis to AC networks, numerical problems on sinusoidal steady state analysis, series and parallel resonance, selectivity, band width and Quality factor, Current Locus diagrams of RL, RC and RLC circuits.

UNIT-IV

Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum-power transfer theorem, Reciprocity theorem, Millman's theorem, Tellegen's theorem and Compensation theorem.

UNIT-V: Balanced and Unbalanced Three phase circuits

Phase sequence, star and delta connection of sources and loads, relation between line and phase voltages and currents, analysis of balanced three phase circuits, measurement of active and reactive power.

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

Course Outcomes:

The students should be able to:

vi. analyze various electrical networks in presence of active and passive elements
vii. explore RLC networks with sinusoidal excitation.
viii. analyze resonance conditions in electrical circuits.
ix. verify various network theorems.
x. solve three- phase circuits under balanced and unbalanced condition

Text Books:

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

Reference Books:

vii. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India).
viii. Linear Circuit Analysis by De Carlo, Lin, Oxford publications.
ix. Electric Circuits – (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, adapted by K. Uma Rao, 5th Edition – McGraw Hill.
x. Electric Circuits by David A. Bell, Oxford publications.
xi. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications.
xii. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi, Dhanpat Rai&Co.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTROMAGNETIC FIELD THEORY	L	T	P	C
	3	1	0	4

Course objectives:
The objective of this course is to acquire knowledge on

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

UNIT – I Electrostatics
Electrostatic Fields – 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 – Maxwell's first law, div(D)=ρ_v Laplace's and Poison's equations and solution of Laplace's equation in one variable.

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 behavior in electric field.
Polarization, boundary conditions between conduction to dielectric and dielectric to dielectrics. Capacitance of parallel plates, spherical and coaxial cables with composite dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity

UNIT – III Magneto statics, Ampere's Law and Force in magnetic fields
Static magnetic field – Biot-Savart's law – Oesterd's experiment, 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, field due to a circular loop, point form of Ampere's circuital law, 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 – simple problems, modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

Course outcomes:

The student should be able to

i. determine electric fields and potentials using guass's law or solving laplace's or possion's equations, for various electric charge distributions.
ii. calculate and design capacitance, energy stored in dielectrics.
iii. calculate the magnetic field intensity due to current, the application of ampere's law and the maxwell's second and third equations and determine the magnetic forces and torque produced by currents in magnetic field.
iv. determine self and mutual inductances and the energy stored in the magnetic field.
v. calculate induced emf, understand the concepts of displacement current and poynting vector.

Text Books:

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

Reference Books:

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CONTROL SYSTEMS	L	T	P	C
	3	1	0	4

Course Objectives:
The objective of this course is to acquire knowledge on

i. mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
ii. time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers and to investigate the stability of closed loop systems using Routh's stability criterion and the analysis by root locus method.
iii. Frequency Response approaches for the analysis of linear time invariant (LTI) systems using Bode plots, polar plots and Nyquist stability criterion.
iv. basic aspects of design and compensation of linear control systems using Bode plots.
v. state models and analyze the systems and also 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, effects of proportional (P), proportional-integral (PI), proportional-integral-derivative (PID) systems.

Stability and root locus technique
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 to the transfer function.

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.

Course Outcomes:

The student should be able to

i. derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
ii. determine time response specifications of second order systems and absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
iii. analyze the stability of LTI systems using frequency response methods.
iv. design Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
v. represent physical systems as state models and determine the response. Understanding the concepts of controllability and observability.

Text Books:

i. Control Systems principles and design by M.Gopal, Tata McGraw Hill education Pvt Ltd., 4th Edition.
ii. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition.

Reference Books:

i. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India.
ii. Control Systems by ManikDhanesh N, Cengage publications.
iii. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
iv. Control Systems Engineering by S.Palani, Tata McGraw Hill Publications.

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FUNDAMENTALS OF ELECTRICAL MACHINES	L	T	P	C
	3	1	0	4

Course objectives:

The objectives of this course is to acquire knowledge on

i. the principle of operation and construction of DC generators and DC motors, characteristics of DC generators.
ii. speed control methods, starting and performance characteristics of DC shunt motor
iii. principle of operation & construction of AC machines (transformers, synchronous machines and 3-phase &1-phase induction motors)
iv. performance characteristics of transformers & 3-phase Induction motors and regulation of transformer and alternators
v. principle of operation & construction of special electrical machines

Unit - I
DC Machines

Principle of operation of DC generator – EMF equation – types of DC machines – OCC & load characteristics of DC shunt generator - Principle of operation of DC motor - torque equation - speed control methods – losses and efficiency – three-point starter - applications – Swinburne's test - brake test - numerical problems.

Unit – II
Transformers

Principle of operation and construction of single-phase transformer – EMF equation – Losses - OC & SC tests - efficiency and voltage regulation of transformer – Numerical Problems.

Unit - III
Synchronous Machines

Principle of operation and construction of alternators- types of alternators – EMF equation - regulation of alternator by synchronous impedance method (EMF Method) - principle of operation and construction of synchronous motor – applications.

Unit IV
Three-Phase Induction Motors

Principle of operation – construction – revolving magnetic field - types of three-phase induction motors – slip-torque characteristics - maximum, starting and running toques - losses and efficiency - starting methods –brake test on 3-phase induction motor.

Unit V
Special Machines:

Principle of operation of single-phase induction motor - different types of single-phase induction motors (split-phase motor, capacitor-start motor, capacitor-start capacitor-run motor, shaded-pole motor) – Linear induction motor – stepper motor - universal motor.

Course Outcomes:

The student should be able to:

i. understand the operation and characteristics of DC machines
ii. acquire the skills to analyze the starting and speed control methods of DC shunt motors.
iii. able to explain the operation of synchronous machines and determine regulation using synchronous impedance method
iv. understand the principle, speed-torque characteristics, performance and starting methods of 3-phase induction motor
v. understand the operation of various special machines.

Text books:

i. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand publications
ii. Theory & performance of Electrical Machines by J.B.Guptha, S.K.Kataria & Sons
iii. Electrical Machinery by P.S. Bhimbra, Khanna Publishers.

Reference books:

i. Basic Electrical Engineering by M.S.Naidu & S.Kamakshiah, TMH Publications
ii. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition
iii. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition

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POWER ELECTRONICS	L	T	P	C
	3	1	0	4

Course Objectives:
The objectives of this course is to acquire knowledge on

i. characteristics of various power semiconductor devices and analyze the operation of silicon-controlled rectifier.
ii. operation of half-wave and full-wave phase-controlled rectifiers and analyze harmonics in the input current.
iii. operation of three phase full-wave converter and dual converter.
iv. operation of ac voltage controller, single phase cyclo converters and high frequency dc-dc converters.
v. working of inverters and application of pwm techniques for voltage control and harmonic mitigation.

UNIT - I: Power Semi-Conductor Devices

Power transistors- Basic structure and working of power MOSFET and power IGBT. Characteristics of power MOSFET and power IGBT-Silicon controlled rectifiers (SCR's)- Basic theory of operation of SCR-Static & Dynamic characteristics of SCR- Turn on and turn off methods of SCR-Snubber circuit Design.

UNIT - II: **Single Phase - Phase Controlled Rectifiers and Harmonic Analysis**

Half wave converters with R, RL and RLE loads- Derivation of average output voltage and output current- Effect of freewheeling diode for RL load. Fully controlled converters with R, RL and RLE loads-Derivation of output voltage and current - Effect of source Inductance. Semi Converters (Half Controlled) operation with R, RL and RLE loads - Harmonic analysis for input/source current waveform in a system with a large load inductance -Calculation of input power factor.

UNIT-III: Three Phase - Phase Controlled Rectifiers
Three Phase Half wave and Full wave converters with R and RL loads-Semi converter (Half Controlled) with R and RL loads- Derivation of average and rms output voltages-Line commutated Inverter operation-Dual converters with non-circulating and circulating currents.

UNIT - IV: AC-AC and DC-DC Converters

Single phase AC voltage controller with R and RL load- Single phase Bridge type Cyclo converter with R and RL load (Principle of operation) -High frequency DC-DC converters: Buck Converter operation, Time ratio control and current limit control strategies-Voltage and current waveforms-Derivation of output voltage-Boost converter operation-Voltage and current waveforms-Derivation of output voltage - Buck-Boost converter operation -Voltage and current waveforms.

UNIT - V: **DC-AC Inverters**
Single phase half bridge and full bridge inverters - Three phase Inverters (120^0 and 180^0 modes of operation) - PWM techniques- Single Pulse, Multiple Pulse and Sinusoidal PWM, amplitude and frequency modulation Indices -Harmonic analysis.

Course Outcomes:

The students should be able to

i. draw the characteristics of various power semiconductor devices and analyze the operation of silicon-controlled rectifier.
ii. analyze the operation of half-wave and full-wave phase-controlled rectifiers and harmonics in the input current.
iii. explain the operation of three phase full converter and dual converter.
iv. explain the operation of AC voltage controller, single phase cyclo converter and high frequency dc-dc converters.
v. apply PWM technique for voltage control and harmonic mitigation.

Text Books:

i. Power Electronics - by P.S.Bhimbra, Khanna Publishers.
ii. Power Electronics: Circuits, Devices and Applications - by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998.
iii. Power Electronics: converters, applications &Design –by Nedmohan, Tore M. Undeland, Robbins by Wiley India Pvt. Ltd.
iv. Power Converter Circuits -by William Shepherd, Li zhang, CRC Taylor & Francis Group.

Reference Books:

i. Power Electronics handbook by Muhammad H. Rashid, Elsevier
ii. Elements of Power Electronics-Philip T.Krein. Oxford.
iii. Thyristorised Power Controllers - by G. K. Dubey, S. R. Doradla, A. Joshi and R. M. K.Sinha, New Age International (P) Limited Publishers, 1996.

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ELECTRICAL MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
	3	1	0	4

Course Objectives:
The objective of this course is to acquire knowledge on

i. classification and usage of various meters to measure current & voltage
ii. applications of potentiometers & instrument transformers.
iii. measurement of active power, reactive power and energy
iv. resistance, inductance and capacitance measuring methods.
v. characteristics and applications of transducers.

UNIT – I: Introduction to measuring instruments: Classification-deflecting, control and damping torques-Ammeters and Voltmeters-PMMC, moving iron type instruments- expression for the deflecting torque and control torque-errors and compensations, extension of range using shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type- Extension of range of E.S. Voltmeters

UNIT – II: Potentiometers & Instrument Transformers: Principle and operation of D.C. Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. A.C. Potentiometers: polar and coordinate types standardization –applications. CT and PT – Ratio and phase angle errors

UNIT - III: Measurement of Power & Energy: Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers – Measurement of active and reactive powers in balanced and unbalanced systems. Singlephase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using R.S.S. meter. Three phase energy meter – tri vector meter, maximum demand meters.

UNIT - IV DC & AC Bridges: Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method. Measurement of inductance, Quality Factor - Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge. Measurement of capacitance and loss angle - Desauty bridge, Wien's bridge –Schering Bridge.

UNIT-V: Transducers: Definition of transducers, Classification of transducers, Advantages of Electrical transducers, Characteristics and choice of transducers; Principle operation of LVDT and capacitor transducers; LVDT Applications, Strain gauge and its principle of operation, gauge factor, Thermistors, Thermocouples, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes.

Course Outcomes:

The student should be able to

i. compare the different types of measuring instruments, their construction, operation and characteristics.
ii. measure the voltage and current through potentiometers and instrument transformers
iii. choose the suitable method for measurement of active, reactive powers and energy.
iv. apply the suitable method for measurement of resistance, inductance and capacitance.
v. apply the knowledge about transducers effectively.

Text Books:

i. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications
ii. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
iii. 3. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:

i. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
ii. Electrical Measurements by Buckingham and Price, Prentice – Hall
iii. Electrical Measurements by Forest K. Harris. John Wiley and Sons
iv. Electrical Measurements: Fundamentals, Concepts, Applications byReissland, M.U, New Age International (P) Limited, Publishers.
v. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL POWER GENERATION & ECONOMIC CONCEPTS	L	T	P	C
	3	1	0	4

Course Objectives:
The objectives of this course is to acquire knowledge on

i. principle of operation of different components of a thermal power stations.
ii. principle of operation of different components of a Nuclear power stations.
iii. constructional and operation of different components of an Air and Gas Insulated substations.
iv. constructional details of different types of cables.
v. 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.
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.

Course Outcomes:

The student should be able to

i. identify the different components of thermal power plants.
ii. identify the different components of nuclear power plants.
iii. identify the different components of air and gas insulated substations.
iv. identify single core and three core cables with different insulating materials.
v. analyse the different economic factors of power generation and tariffs.

Text Books:

i. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagarand Chakrabarti, DhanpatRai& Co. Pvt. Ltd.
ii. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa New age International (P) Limited, Publishers.

Reference Books:

i. Electrical Power Distribution Systems by V. Kamaraju, TataMcGraw Hill, New Delhi.
ii. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.

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RENEWABLE ENERGY SOURCES	L	T	P	C
	3	1	0	4

Course Objectives:
The objectives of this course is to acquire knowledge on

i. basics of energy systems, solar energy and solar thermal Systems.
ii. solar photo voltaic systems construction characteristics and design.
iii. wind energy conversion systems, Betz coefficient, tip speed ratio and maximum power point techniques of wind energy.
iv. basic principle and working of hydro, tidal.
v. basic principle and working of different fuel cells, biomass digesters and geothermal systems.

UNIT – I Fundamentals of Energy Systems, Solar Energy and Solar Thermal Systems
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 -Liquid flat plate collectors**:** Performance analysis –Transmissivity– Absorptivity product collector efficiency factor – Collector heat removal factor. Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants

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.

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

Course Outcomes:

The students should be able to

i. analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface solar thermal collectors, solar thermal plants.
ii. design solar photo voltaic systems, maximum power point techniques in solar pv
iii. develop wind energy conversion systems, wind generators, power generation and wind energy systems.
iv. explain basic principle and working of hydro, tidal energy sytems.
v. explain biomass, fuel cell and geothermal systems.

Text Books:

i. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
ii. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis -second edition,2013.

Reference Books:

i. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
ii. Renewable Energy- Edited by Godfrey Boyle-oxford university. press,3rd edition,2013.
iii. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
iv. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
v. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
vi. Non-conventional energy source –B.H.khan- TMH-2nd edition.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ENERGY STORAGE SYSTEMS	L	T	P	C
	3	1	0	4

Course Objectives:

The objectives of this course is to acquire knowledge on

i. need of energy storage and different types of energy storage.
ii. thermal, magnetic, electrical and electrochemical energy storage systems.
iii. emerging needs for EES pertaining to Renewable energy
iv. types of electrical energy storage systems
v. Design and Applications of Electrical Energy Storage

UNIT - I: Introduction:
Necessity of energy storage, different types of energy storage, mechanical, chemical, electrical, electrochemical, biological, magnetic, electromagnetic, thermal, comparison of energy storage technologies

UNIT - II: Energy Storage Systems:
Thermal Energy storage-sensible and latent heat, phase change materials, Energy and exergy analysis of thermal energy storage, Electrical Energy storage-super-capacitors, Magnetic Energy storage-Superconducting systems, Mechanical-Pumped hydro, flywheels and pressurized air energy storage, Chemical-Hydrogen production and storage, Principle of direct energy conversion using fuel cells, thermodynamics of fuel cells, Types of fuel cells, Fuel cell performance, Electrochemical Energy Storage- Battery, primary, secondary and flow batteries.

UNIT – III: Needs for Electrical Energy Storage:
Emerging needs for EES, more renewable energy, less fossil fuel, Smart Grid uses - the roles of electrical energy storage technologies-the roles from the viewpoint of a utility-the roles from the viewpoint of consumers-the roles from the viewpoint of generators of renewable energy.

UNIT - IV: Types of Electrical Energy Storage systems:
Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

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

Course Outcomes:
The students should be able to:

i. know the characteristics of electricity and need for continuous and flexible supply
ii. understand the role of electrical energy storage technologies
v. analyse features of EES systems
vi. acquire knowledge on various types of EES systems
v. apply EES systems to various applications such as smart micro grid, smart home etc.

Text Books:

i. Energy Storage - Technologies and Applications by Ahmed Faheem Zobaa, InTech.
ii. Fundamentals of Energy Storage by J. Jensen and B. Sorenson, Wiley-Interscience, New York,
iii. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.

Reference Books:

i. Thermal energy storage: Systems and Applications by Dincer I. and Rosen M. A., Wiley pub.
ii. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer.
iii. Electric & Hybrid Vehicles by G. Pistoia, Elsevier B. V.
iv. Fuel cell Fundamentals by R. O'Hayre, S. Cha, W. Colella and F. B. Prinz, Wiley Pub.

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TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER	L	T	P	C
	3	1	0	4

Course Objectives:

The objective of this course is to acquire knowledge to

i. compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
ii. study the Short and Medium length transmission lines, their models and performance.
iii. study the performance and modeling of long transmission lines.
iv. study the effect of travelling waves on transmission lines and study the factors affecting the performance of transmission lines and power factor improvement methods.
v. 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-Numerical Problems–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–Numerical Problems.

UNIT - II: Performance of Short and Medium Transmission Lines

Classification of Transmission Lines – Short, medium, long line and their model representations –Nominal-T– Nominal-π and A, B, C, D Constants for symmetrical and Asymmetrical Networks– Numerical Problems– Mathematical Solutions to estimate regulation and efficiency of all types of lines – Numerical Problems.

UNIT - III: Performance of Long Transmission Lines

Long Transmission Line–Rigorous Solution – Evaluation of A,B,C,D Constants–Interpretation of the Long Line Equations, regulation and efficiency– Incident, Reflected and Refracted Waves –Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves – Representation of Long Lines – Equivalent-T and Equivalent πnetwork models-Numerical Problems.

UNIT-IV: Power System Transients &Factors governing the Performance of Transmission line

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. Skin and Proximity effects – Description and effect on Resistance of Solid Conductors –Ferranti effect – Charging Current –Shunt Compensation –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–Numerical Problems – Stringing chart and sag template and its applications–Types of Insulators – String efficiency and Methods for improvement–Numerical Problems – Voltage distribution–Calculation of string efficiency–Capacitance grading and Static Shielding.

Course Outcomes:

The students should be able to

i. know various transmission line parameters during different operating conditions.
ii. know the performance of short and medium transmission lines.
iii. analyze the performance of long transmission line.
iv. discuss about corona phenomenon and compute the power loss due to corona.
v. calculate sag of overhead transmission lines and string efficiency of insulators.

Text Books:

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

Reference Books:

i. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition.
ii. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
iii. A Text Book on Power System Engineering by L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarthy, DhanpatRai & Co.Pvt. Ltd.
iv. Power System Analysis, Arthur R. Bergen, Pearson Education.
v. Electrical Power Systems by P.S.R. Murthy, B.S.Publications

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
UNIVERSITY COLLEGE OF ENGINEERING VIZIANAGARAM (AUTONOMOUS)
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UTILIZATION OF ELECTRICAL ENERGY	L	T	P	C
	3	1	0	4

Course Objectives:
The objectives of this course is to acquire knowledge on

vi. operating principles and characteristics of electric drives.
vii. different types of electric heating and welding techniques.
viii. basics of illumination and design of lightning system.
ix. features of traction motor and speed time curves.
x. basic principle and method of calculation for tractive effort

UNIT – I:
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.

UNIT – II:
Electric Heating
Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating – Arc furnaces – Direct and indirect arc furnaces
Electric Welding
Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT – III:
Illumination fundamentals
Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Discharge lamps, MV and SV lamps – Lumen or flux method of calculation - Sources of light.
Various Illumination Methods
Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and Design of lighting and flood lighting–LED lighting, principle of operation, street lighting and domestic lighting.
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-High speed transportation trains.

UNIT – V:
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-Modern traction motors.

Course Outcomes:

The students should be able to

vi. identify a suitable motor for electric drives and industrial applications
vii. identify most appropriate heating or welding techniques for suitable applications.
viii. estimate the illumination levels and design
ix. determine the speed/time characteristics of different types of traction motors.
x. estimate energy consumption levels at various modes of operation.

Text Books:

iii. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
iv. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai&Sons.

Reference Books:

iii. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.
iv. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

ELECTRICAL SAFETY COURSE	L	T	P	C
	3	1	0	4

Course Objectives:

The objectives of this course is to acquire knowledge on the

i. basic concepts of the electric grid and electrical equipment
ii. severity of electric shock
iii. ground resistance of various objects and general hazards of electricity
iv. de-energized and live-line works on electrical power systems
v. electrical safety under power lines.

UNIT - I: Basic Concepts of an Electric Grid:
Power lines-conductors, Insulators, Substation equipment-transformers, circuit breakers, circuit reclosers, circuit sectionalizers, isolators and bypasses, load switches, fuses, surge protectors, measuring equipment, reactive power control equipment.

UNIT - II: Physiological Effects of electricity:
Classification of Electric shocks, Factors determining the severity of electric shocks-effect of voltage, current, body resistance, current pathway, shock duration, frequency and impulse versus continuous current; Micro-shocks.

UNIT - III: Ground resistance:
Ground resistance of objects, measuring ground resistance, factors affecting ground resistance, , General hazards of Electricity.

UNIT - IV: De-energized and Live-line works:
De-energized Line works: Definition of a De-energized conductor, methods of detecting induced voltage, main protection techniques, ground system, grounding methods, case studies
Live-line works: Hot-Stick Method, insulate and isolate method, bare-hand method, case study

UNIT - V: Electrical Safety under power lines:
Electric field calculation, electric field near objects, electric field profile under power lines, allowable limits for electric fields, minimum vertical clearance methods, measurement of electrical field strength, mitigation of electric field.

Course Outcomes:
The students should be able to:

i. know the main components of substations and transmission lines.
ii. analyse the biological impact of electric current and various factors affecting the severity of electric shocks.
iii. measure the ground resistance and understand the hazards of electricity.
iv. analyze the de-energised and energised line works by considering all safety precautions by analysing several real-life case studies.
v. evaluate the electric field profile in the right-of-way and vertical clearance of towers.

Text Books:

i. Electric safety: Practice and satndards, Mohamed EI-Sharkawi,CRC press, Taylor & Francis group
ii. Electrical Safety Handbook, 4th Edition, John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield

Reference Books:

i. Electrical Safety Code manual-A plain language guide to national electrical code, OSHA and NFPA 70E, Kimberly Keller, Elsevier Publishers
ii. Electrical Installations in Hazardous Areas, Alan McMillan, Butterworth-Heinemann Publisher.