R19 – UCEK – EEE Syllabus w.e.f 2019-20

COURSE STRUCTURE

I Year – I SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1	BS1101	Mathematics – I			3	0	0	3
2	HS1101	Communicative English			3	0	0	3
3	BS1203	Applied Chemistry			3	0	0	3
4	ES1101	Fundamentals of Computers			3	0	0	3
5	HS1102	English communication skills Lab - I			0	0	2	1
7	BS1204	Applied Chemistry Lab			0	0	3	1.5
8	ES1104	IT Workshop			0	0	2	1
9	ES1105	Electrical Engineering Workshop			0	0	2	1
10	MC1101	Environmental Science			3	0	0	0
11	MC1102	Physical Fitness Activities			2	0	0	0
		Total Credits			**17**	**0**	**9**	**16.5**

I Year – II SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1	BS1201	Mathematics – II			3	0	0	3
2	BS1202	Mathematics – III			3	0	0	3
3	BS1102	Applied Physics			3	0	0	3
4	ES1201	Problem Solving and Programming using C			3	0	0	3
5	ES1202	Electrical Circuit Analysis - I			3	0	0	3
6	ES1103	Engineering Drawing			1	0	3	2.5
7	HS1103	English Communication Skills Lab- II			0	0	3	1.5
8	BS1103	Applied Physics Lab			0	0	3	1.5
9	BS1205	Physics Virtual Lab			0	0	2	0
10	ES1203	Problem Solving and Programming using C Lab			0	0	3	1.5
11	PR1201	Engineering Exploration Project - Design Thinking (15 Hrs per Sem.)			0	0	0	0.5
12	MC1201	Constitution of India			3	0	0	0
		Total Credits			**19**	**0**	**14**	**22.5**

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II Year – I SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Electronic Devices and Circuits		ES	3	0	0	3
2		Thermal and Hydro Prime Movers		ES	2	0	0	2
3		Digital Electronics		ES	3	0	0	3
4		Electrical Circuit Analysis – II		PC	3	0	0	3
5		Electrical Machines-I		PC	3	0	0	3
6		Electro Magnetic Fields		PC	3	0	0	3
7		Power System-I		PC	3	0	0	3
8		Electrical Circuits Lab		PC	0	0	3	1.5
9		Thermal and Hydro Lab		ES	0	0	2	1
10		Essence of Indian Traditional Knowledge		MC	3	0	0	0
11		Employability Skills-I		MC	3	0	0	0
		Total Credits			**26**	**0**	**5**	**22.5**

II Year – II SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Signals and Systems		ES	3	0	0	3
2		Managerial Economics & Financial Analysis		HSSMS	3	0	0	3
3		Electrical Machines-II		PC	3	0	0	3
4		Control Systems		PC	3	0	0	3
5		Electrical Measurements and Instrumentation		PC	3	0	0	3
6		Electrical Machines Lab -I		PC	0	0	3	1.5
7		Electronic Devices & Circuits Lab		ES	0	0	3	1.5
8		Electrical Simulation Lab		PC	0	0	2	1
9		Professional Ethics and Human Values		MC	3	0	0	0
10		Socially Relevant Projects- I		MC	0	0	1	0.5
		Total Credits			**18**	**0**	**9**	**19.5**

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III Year – I SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Power Systems-II		PC	3	0	0	3
2		Power Electronics		PC	3	0	0	3
3		Linear IC Applications		ES	3	0	0	3
4		Digital Signal Processing		PC	3	0	0	3
5		Program Elective -I		PC	3	0	0	3
6		Electrical Machines –II Laboratory		PC	0	0	3	1.5
7		Control Systems Laboratory		PC	0	0	3	1.5
8		Electrical Measurements and Instrumentation Laboratory		PC	0	0	3	1.5
9		Socially Relevant Projects-II		MC	0	0	1	0.5
10		Employability Skills-II		MC	3	0	0	0
		Total Credits			**18**	**0**	**10**	**20**

III Year – II SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Electric Drives		PC	3	0	0	3
2		Power System Analysis		PC	3	0	0	3
3		Microprocessors and Microcontrollers		PC	3	0	0	3
4		Open Elective-I		OE	3	0	0	3
5		Program Elective –II		PE	3	0	0	3
6		Program Elective –III		PE	3	0	0	3
7		Power Electronics Laboratory		PC	0	0	3	1.5
8		Linear IC Applications Laboratory		ES	0	0	3	1.5
9		Value Education		MC	3	0	0	0
		Total Credits			**21**	**0**	**6**	**21**

IV Year – I SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Switchgear and Protection		PC	3	0	0	3
2		Power System Operation and Control		PC	3	0	0	3
3		Program Elective -IV		PE	3	0	0	3
4		Program Elective -V		PE	3	0	0	3
5		Open Elective-II		OE	3	0	0	3
6		Microprocessors and Microcontrollers Laboratory		PC	0	0	3	1.5
7		Power Systems and Simulation Laboratory		PC	0	0	3	1.5
8		Industrial Training /Skill Development Programmes / Research Project		Project	0	0	2	1
9		Project-Work Phase -I		Project	0	0	4	2
10		Universal Human Values 2: Understanding Harmony		MC	3	0	0	0
		Total Credits			**15**	**0**	**12**	**21**

IV Year – II SEMESTER

S. No	Course Code	Subjects	P.Os	Category	L	T	P	Credits
1		Program Elective –VI		PE	3	0	0	3
2		Program Elective -VII		PE	3	0	0	3
3		Open Elective-III		OE	3	0	0	3
4		Project-Work Phase -II		Project	0	0	16	8
		Total Credits			**9**	**0**	**16**	**17**

BS – Basic Sciences
HSSMS – Humanity Social Sciences
ES – Engineering Sciences
MC–Mandatory Course

PC – Program Core
OE – Open Elective
PE – Program Elective

Program Elective – I:

1.	Python Programming
2.	Data Structures
3.	OOPS through JAVA
4.	Operating Systems

Program Elective – II:

1.	Energy Auditing Conservation and Management
2.	Electrical Distribution Systems
3.	Renewable Energy Technologies
4.	Special Electric Machines

Program Elective – III:

1.	IoT Applications in Electrical Engineering
2.	Data Base Management Systems
3.	Data Analytics with Python
4.	Cloud Computing

Program Elective – IV:

1.	HVDC Transmission
2.	EHVAC Transmission
3.	Flexible Alternating Current Transmission Systems
4.	High Voltage Engineering

Program Elective – V:

1.	Utilization of Electrical Energy
2.	Smart Grid Technologies
3.	Power System Deregulation
4.	Hybrid Electric Vehicles

Program Elective – VI:

1.	AI Applications in Electrical Engineering
2.	VLSI Design
3.	Cyber Security
4.	Electrical Machine Design

Program Elective – VII:

1.	Switch Mode Power Conversion
2.	Embedded Systems
3.	Programmable Logic Controllers & its Applications
4.	Communication Systems

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

Open Elective-I:

1.	Renewable Energy Sources
2.	Energy Auditing. Conservation and Management
3.	Optimization Techniques

Open Elective-II:

1.	AI Techniques and its Applications
2.	Linear Control Systems
3.	Measurements and Instrumentation

Open Elective-III:

1.	Microprocessors and Microcontrollers Applications
2.	Fundamentals of utilization of Electrical Energy
3.	Electrical Estimation and Costing

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12 Weeks & 8 Weeks NPTEL courses for Minor Engineering

S.No	Course Name	Type	Duration	Last date for registration
1.	Principles of Signals and Systems	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
2.	Discrete Time Signal Processing	Rerun	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM
3.	Integrated Circuits, MOSFETs, OP-Amps and their Applications	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
4.	Analog Circuits	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
5.	Analog Circuits and Systems through SPICE Simulation	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
6.	Digital Electronic Circuits	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
7.	Advance power electronics and Control	Rerun	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM
8.	Fundamentals of semiconductor devices	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
9.	Architectural Design of Digital Integrated Circuits	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
10.	Microprocessors And Microcontrollers	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
11.	Electrical Machines - II	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
12.	Power System Engineering	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
13.	Control engineering	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
14.	Signals and Systems	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
15.	Network Analysis	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
16.	Analog Electronic Circuits	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
17.	High Power Multilevel Converters- Analysis, design and operational issues	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
18.	Digital IC Design	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
19.	Microprocessors and Interfacing	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
20.	Power Management Integrated Circuits	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
21.	VLSI Signal Processing	New	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM

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R19 – UCEK – EEE Syllabus w.e.f 2019-20

12 Weeks & 8 Weeks NPTEL courses for Honour Engineering

S.NO	Course Name	Type	Duration	Last date for registration
1.	Mathematical Methods and Techniques in Signal Processing	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
2.	Advance power electronics and Control	Rerun	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM
3.	Analog IC Design	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
4.	Architectural Design of Digital Integrated Circuits	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
5.	CMOS Digital VLSI Design	Rerun	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM
6.	Control engineering	Rerun	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
7.	Nonlinear System Analysis	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
8.	Fuzzy Sets, Logic and Systems & Applications	New	12 weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
9.	Transmission lines and electromagnetic waves	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
10.	Power Management Integrated Circuits	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
11.	DC Power Transmission Systems	New	12 Weeks	Mar 16, 2020/Mar 20, 2020 10:00 AM
12.	Power Quality Improvement Technique	New	8 Weeks	Feb 17, 2020/Feb 21, 2020 10:00 AM

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I Year – I SEMESTER

L	T	P	C
3	0	0	3

MATHEMATICS - I

After learning the course, the student will be able:

CO. No	Description	Knowledge Level
CO1	**utilize** mean value theorems to real life problems	L3
CO2	**solve** the differential equations related to various engineering fields	**L3**
CO3	**familiarize** with functions of several variables which is useful in optimization	**L3**
CO4	**apply** double integration techniques in evaluating areas bounded by region. Students will also learn important tools of calculus in higher dimensions. Students will become **familiar** with 2-dimensional and 3-dimensional coordinate systems	**L3**
CO5	**conclude** the use of special function in multiple integrals	**L4**

Correlation Levels as :															
			1=LOW			**2=MODERATE**				**3=HIGH**					
CO	***PO1***	***PO2***	***PO 3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PO12***	***PS O1***	***PS O2***	***PS O3***
CO1	2	2										1			
CO2	3	3										2	3		
CO3	2	3										2	2		
CO4	3	3										2	2		
CO5	2	2										1	1		

Syllabus:

UNIT – I: Sequences, Series and Mean value theorems: (10 hrs)
Sequences and Series: Convergences and divergence – Ratio test – Comparison tests – Integral test – Cauchy's root test – Alternate series – Leibnitz's rule.

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

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

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 Mc Laurent's series expansion of functions of two variables.
Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method (with constraints).

UNIT – IV: Multiple integrals: (8 hrs)

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

UNIT – V: Special functions: (5 hrs)

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

Text Books:

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

Reference Books:

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

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	L	T	P	C
I Year – I SEMESTER	**3**	**0**	**0**	**3**

COMMUNICATIVE ENGLISH

Communicative English (Theory)

L	T	P	C
3	0	0	3

Introduction

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

Course Objectives

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

Learning Outcomes

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

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

P. Rajendra Kashyap 28/06/19

(28/6/19)

28/6/19

Unit 1:

Lesson-1: A Drawer full of happiness from "**Infotech English**", Maruthi Publications

Lesson-2: Deliverance by Premchand from "**The Individual Society**", Pearson Publications. (Non-detailed)

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

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

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

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

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

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

Pronunciation: Vowels, Consonants, Plural markers and their realizations

Unit 2:

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

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

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

P. Rajendra Karmarkar 28/06/19

(28/6/19)

28/6/19

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

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

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

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

Grammar: Use of articles and zero article; prepositions.

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

Unit 3:

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

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

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

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

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

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

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

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

P. Rajendra Karmakar 28/06/19

(28/6/19)

28/6/19

Pronunciation: word stress-poly-syllabic words

Unit 4:

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

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

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

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

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

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

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

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

Pronunciation: Contrastive Stress

Unit 5:

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

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

P. Rajendra Kumar 28/06/19

(28/6/19)

28/6/19

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

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

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

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

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

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

Pronunciation: Stress in compound words

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

Prescribed **text book for Laboratory for Semesters-I & II:**
1. **"Infotech English"**, Maruthi Publications. (with Compact Disc)

Reference Books

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

P. Rajendra Kumar 28/6/19

(28/6/19)

28/6/19

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	L	T	P	C
I Year – I SEMESTER	**3**	**0**	**0**	**3**

APPLIED CHEMISTRY

UNIVERSITY COLLEGE OF ENGINEERING ANNEXURE - V

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

I B. Tech. APPLIED CHEMISTRY (circuit branches)

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

Learning Objectives:

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

POLYMER TECHNOLOGY

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

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

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

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

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

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

UNIT II: ELECTROCHEMICAL CELLS AND CORROSION

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

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

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

- ***Explain*** the theory of construction of battery and fuel cells.
- ***Categorize*** the reasons for corrosion and study some methods of corrosion control.

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- *Categorize* the reasons for corrosion and study some methods of corrosion control.

UNIT III: MATERIAL CHEMISTRY

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

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

Part II:

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

Liquid crystals:- Introduction-types-applications.

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

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

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

UNIT IV: ADVANCED CONCEPTS/TOPICS IN CHEMISTRY

Computational chemistry: Introduction, Ab Initio studies, DFT; TD-DFT calculations using Guassian software

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

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

- ***Obtain*** the knowledge of computational chemistry
- ***Understand*** importance molecular machines

UNIT V: SPECTROSCOPIC TECHNIQUES & NON CONVENTIONAL ENERGY SOURCES

Part A: **SPECTROSCOPIC TECHNIQUES**

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

Part B: NON CONVENTIONAL ENERGY SOURCES

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

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

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

Text Books:

3. Engineering Chemistry by Jain and Jain; Dhanpat Rai Publicating Co. Latest edition
4. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2019 edition

Reference Books:

3. A text book of engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., Latest Edition
4. Engineering Chemistry by Shashi Chawla; Dhanpat Rai Publicating Co. Latest edition

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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R19 – UCEK – EEE Syllabus w.e.f 2019-20

I Year – I SEMESTER

L	T	P	C
3	0	0	3

FUNDAMENTALS OF COMPUTERS

Preamble:

The digital computers are playing a vital role in day to day life of human beings. The main aim of this course is to make the students to understand the working and applications of digital computers.

Course objectives:

- To study different types and working of a digital computer.
- To learn different number systems and representation of floating point numbers.
- To understand the need and working of memory and other peripheral devices.
- To be familiar with internal organization of a computer.
- To study the interconnection of computers and applications of computer.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	2	--	--	--	--	--	1	2	--	1	1	1
CO2	3	2	--	--	--	--	--	--	--	--	--	--	2	1	2
CO3	2	2	2	2	1	--	--	--	--	2		--	1	2	1
CO4	2	2		2	1	--	--	--	--	2	2	2	1	2	2
CO5	2	2	2	1	1	--	--	--	--	2	2	2	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit-I: Introduction:

History of digital computers, types of computers, block diagram of a digital computers, Various properties of a digital computer, computer programming-Machine language, assembly language and high-level language programming.

Unit-II: Number systems

Binary, octal, Decimal and Hexadecimal number systems. Conversion of numbers from one system to other system. Fixed point and floating-point representation of numbers, Addition and Subtraction, Multiplication Algorithms. Division Algorithms. Floating- point Arithmetic operations.

Unit-III: Memory and Peripherals

Memories: Need for memory, types of computer memories-magnetic, Dynamic and Static memories, RAM, ROM, EPROM and EEROM memories, cache memory, concept of virtual memory.

Peripheral Devices: Working of keyboard and Mouse, types of printers and its working, I/O ports, addressing I/O devices-Programmed I/O, Interrupt I/O, DMA.

Unit-IV: Computer Organization

Organization of a processor- Registers, ALU and Control Unit, Register transfer language, Micro operation, instruction codes, computer instruction, instruction formats, instruction cycle, memory reference instructions, Input-output instruction, control memory, address sequencing, design of control unit- micro programmed control, hard wired control.

Unit-V: Applications

Various applications of computers, networking of computers-LAN, WAN, MAN, Internet, internet of thing(IoT) applications to electrical engineering.

Course Outcomes:

- Understand the functioning and programming of computers.
- Convert numbers from one type of system to other type of system
- Distinguish between different types of memories and learn the mapping of I/O devices.
- Demonstrated the internal organization of digital computer.
- Apply digital computers for storing electrical engineering problems.

Text Books:

1. Computer Fundamentals By PK Sinha, 6th Edition, BPB publication.
2. Fundamentals of Computers by E. Balagurusamy, McGrawHill edition.
3. Computer Fundamentals by Anitha Goel, Pearson education
4. Computer system Architecture – M.Moris Mano, 3rd edition , PHI publication.
5. Computer Organization and Architecture by V.Rajaraman and T.Radhakrishnaan, PHI publication.

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L	T	P	C
0	0	2	1

ENGLISH COMMUNICATION SKILLS LAB - I

TOPICS

UNIT I:

Pronunciation: Vowels, Consonants, Phonetic Transcription

UNIT II:

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

UNIT III:

Rhythm & Intonation

UNIT IV:

Contrastive Stress (Homographs)

UNIT V:

Word Stress: Weak and Strong forms
Stress in compound words

Prescribed text book: "**Infotech English**", Maruthi Publications.

References:

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

P. Rajendra, Chairman 28/06/2019

28/6/19

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L	T	P	C
0	0	3	1.5

APPLIED CHEMISTRY LAB

UNIVERSITY COLLEGE OF ENGINEERING
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

COURSE CODE	APPLIED CHEMISTRY/ENGINEERING CHEMISTRY LAB	CATEGORY	3-0-0	1.5

Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis

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

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

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

Reference Books

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

I Year – I SEMESTER	L	T	P	C
	0	0	2	1

IT WORKSHOP

IT WORKSHOP

Objectives:

- **PC Hardware:** Identification of basic peripherals, Assembling a PC, Installation of system software like MS Windows, device drivers, etc. Troubleshooting of PC Hardware and Software issues.
- **Internet & World Wide Web:** Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums. Awareness of cyber hygiene (protecting the personal computer from getting infected with the viruses), worms and other cyber attacks.
- **Productivity Tools:** Understanding and practical approach of professional word documents, excel spread sheets, power point presentations and personal web sites using the Microsoft suite office tools.

Course Outcomes:

List of Exercises:

(Faculty to consolidate the workshop manuals using the textbook and references)

Task 1: Identification of the peripherals of a computer - Prepare a report containing the block diagram of the computer along with the configuration of each component and its functionality. Describe about various I/O Devices and its usage.

Task 2: Practicing disassembling and assembling components of a PC

Task 3: Installation of Device Drivers, MS windows, Linux Operating systems and Disk Partitioning

Task 4: Introduction to Memory and Storage Devices, I/O Port, Assemblers, Compilers, Interpreters, Linkers and Loaders.

Task 5: Demonstration of Hardware and Software Troubleshooting

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices- Gateway, Routers, Hub, Bridge, NIC, Bluetooth Technology, Wireless Technology, Modem, DSL, and Dialup Connection.

Task 7: Awareness of various threats on the Internet and its solutions

Task 8: Demonstration and Practice on Microsoft Word

Task 9: Demonstration and Practice on Microsoft Excel

K. Kiran L. Suralatty 28.06.2019

Task 10: Demonstration and Practice on Microsoft Power Point

Task 11: Demonstration and Practice on LaTeX

TEXT BOOK:

1 Computer Fundamentals, Anita Goel, Pearson India Education, 2017
2 PC Hardware Trouble Shooting Made Easy, TMH

REFERENCE BOOK:

1. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson,2008
2. Comdex Information Technology, Vikas Gupta, Dreamtech.
3. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr. N.B. Venkateswarlu
4. Information Technology Workshop, 3e, G Praveen Babu, M V Narayana BS Publications

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L	T	P	C
0	0	2	1

ELECTRICAL ENGINEERING WORKSHOP

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	--	--	--	--	--	--	--	3	3	--	--	1	--	--
CO2	3	--	--	--	--	--	--	--	3	3	--	--	1	--	--
CO3	3	--	--	--	--	--	--	--	3	3	--	--	1	--	--
CO4	3	--	--	--	--	--	--	--	3	3	--	--	1	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any 10 of the following experiments are to be conducted

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

Course Outcomes:

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

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III B.Tech I Semester

COURSE CODE – R2011XXYY	ENVIRONMENTAL SCIENCE	CATEGORY MC	L-T-P 2-0-0	CREDITS 0

Pre-requisite:

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

		Knowledge Level (K)#
CO1	Understand ecosystem and its function in the environment.	
CO2	Acquire knowledge on the natural resources and their importance.	
CO3	Recognize the biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.	
CO4	Know various attributes of the pollution and their impacts and measures to reduce or control the pollution along with waste management practices.	
CO5	Beware of social issues both rural and urban environment and possible means to challenges like environmental impact assessment and the stages involved in EIA and the environmental audit.	

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	--	--	--	--	--	3	2	--	--	--	1	--	--	1
CO2	--	1	--	--	--	--	3	2	--	--	--	2	--	--	1
CO3	--	--	--	--	--	1	3	2	--	--	--	1	--	--	1
CO4	--	--	--	--	--	2	3	2	--	--	--	2	--	--	1
CO5	--	--	--	--	--	2	3	2	--	1	--	1	--	--	1

(Please fill the above with Levels of Correlation - viz. - L - M - H)

UNIT	CONTENTS	Contact Hours
UNIT - 1	**Multidisciplinary nature of Environmental Studies:** Definition, Scope and Importance – Sustainability: Stockholm and Rio Summit–Global Environmental Challenges: Global warming and climate change, acid rains, ozone layer depletion, population growth and explosion, effects;. Role of information technology in environment and human health. **Ecosystems:** Concept of an ecosystem. - Structure and function of an ecosystem; Producers, consumers and decomposers. - Energy flow in the ecosystem - Ecological succession. - Food chains, food webs and ecological pyramids; Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems.	
UNIT - 2	**Natural Resources:** Natural resources and associated problems. Forest resources: Use and over – exploitation, deforestation – Timber extraction – Mining, dams and other effects on forest and tribal people. Water resources: Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems.	

	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Land resources: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification; Role of an individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.	
UNIT - 3	**Biodiversity and its conservation:** Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.	
UNIT - 4	**Environmental Pollution:** Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, Nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Sustainable Life Studies. Impact of Fire Crackers on Men and his well being. **Solid Waste Management:** Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.	
UNIT - 5	**Social Issues and the Environment:** Urban problems related to energy - Water conservation, rain water harvesting - Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness. **Environmental Management**: Impact Assessment and its significance various stages of EIA, preparation of EMP and EIS, Environmental audit. Ecotourism, Green Campus – Green business and Green politics. The student should Visit an Industry / Ecosystem and submit a report individually on any issues related to Environmental Studies course and make a power point presentation.	
	Total	

Text Books:

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

Reference Books:

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

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2	0	0	0

PHYSICAL FITNESS ACTIVITIES

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I Year – II SEMESTER

L	T	P	C
3	0	0	3

MATHEMATICS - II

After learning the course, the student will be able:

CO. No	Description	Knowledge Level
CO1	**develop** the use of matrix algebra techniques that is needed by engineers for practical applications	L6
CO2	**solve** system of linear algebraic equations using Gauss elimination, Gauss Jordan, Gauss Seidel	**L3**
CO3	**evaluate** the approximate roots of polynomial and transcendental equations by different algorithms	**L5**
CO4	**apply** Newton's forward & backward interpolation and Lagrange's formulae for equal and unequal intervals	**L3**
CO5	**apply** numerical integral techniques to different Engineering problems **apply** different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations	**L3**

Correlation Levels as :															
			1=LOW				**2=MODERATE**			**3=HIGH**					
CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PO12***	***PSO1***	***PSO2***	***PSO3***
CO1	3	3	--	--	--	--	--	--	--	--	--	2	3	--	--
CO2	2	2	--	--	--	--	--	--	--	--	--	2	3	--	--
CO3	3	3	--	--	--	--	--	--	--	--	--	2	2	--	--
CO4	3	2	--	--	--	--	--	--	--	--	--	2	1	--	--
CO5	3	3	--	--	--	--	--	--	--	--	--	3	3	--	--

Syllabus:

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

Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous equations linear equations – Gauss Elimination for solving system of equations – Eigen values and Eigen vectors and their properties.
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 – Bisection method – Secant method – Method of false position – Iteration method – Newton-Raphson method (One variable and simultaneous Equations) – Jacobi and Gauss-Seidel methods for solving system of equations – Power Method for finding Largest Eigenvalue –Eigenvector.

UNIT – IV: Interpolation: (10 hrs)

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

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

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

Text Books:

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

Reference Books:

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

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L	T	P	C
3	0	0	3

MATHEMATICS - III

After learning the course, the student will be able:

CO. No	Description	Knowledge Level
CO1	**interpret** the physical meaning of different operators such as gradient, curl and divergence	L5
CO2	**estimate** the work done against a field, circulation and flux using vector calculus	**L5**
CO3	**apply** the Laplace transform for solving differential equations	**L3**
CO4	**find** or **compute** the Fourier series of periodic signals and be able to **apply** integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms	**L3**
CO5	**identify** solution methods for partial differential equations that model physical processes	**L3**

Correlation Levels as :															
			1=LOW				**2=MODERATE**				**3=HIGH**				
CO	***PO1***	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***	***PO12***	***PSO1***	***PSO2***	***PSO3***
CO1	3	3	--	--	--	--	--	--	--	--	--	2	3	--	--
CO2	3	2	--	--	--	--	--	--	--	--	--	2	2	--	--
CO3	3	3	--	--	--	--	--	--	--	--	--	2	3	--	--
CO4	2	2	--	--	--	--	--	--	--	--	--	1	2	--	--
CO5	2	3	--	--	--	--	--	--	--	--	--	2	2	--	--

Syllabus:

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

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

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

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

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

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

UNIT – III: Fourier series and Fourier Transforms: (10 hrs)

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

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

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

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

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

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

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

Text Books:

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

Reference Books:

1. **Erwin Kreyszig,** Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. **Dean. G. Duffy,** Advanced Engineering Mathematics with MATLAB, 3rd Edition, CRC Press.
3. **Peter O' Neil,** Advanced Engineering Mathematics, Cengage.
4. **Srimantha Pal, S C Bhunia,** Engineering Mathematics, Oxford University Press.

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

	L	T	P	C
I Year – II SEMESTER	**3**	**0**	**0**	**3**

APPLIED PHYSICS

APPLIED PHYSICS
(for circuital branches like CSE, ECE, EEE etc)

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

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

UNIT-I
(10hrs)

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

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

Unit Outcomes:

The students will be able to

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

UNIT-II
(9hrs)

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

Unit Outcomes:

The students will be able to

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

Dr.G.Padmaja Rani | Dr.P.Dakshina Murthy | Dr.V.R.K.Murthy | Dr.S.V.S.Ramana Reddy

Dr.R.Padmasuvarna | Dr.K.Samatha

UNIT-III **(10hrs)**

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

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

Unit Outcomes:

The students will be able to

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

UNIT-IV **(9hrs)**

SEMICONDUCTOR PHYSICS: Introduction – Intrinsic semi conductors - density of charge carriers - Electrical conductivity – Fermi level – extrinsic semiconductors - p-type & n-type - Density of charge carriers - Dependence of Fermi energy on carrier concentration and temperature – Hall effect- Hall coefficient - Applications of Hall effect - Drift and Diffusion currents – Einstein's equation.

Learning Outcomes:

The students will be able to

- **classify** the energy bands of semiconductors.
- **outline** the properties of n-type and p-type semiconductors.
- **identify** the type of semiconductor using Hall effect.

UNIT-V **(10 hrs)**

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

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

Dr.G.Padmaja Rani | Dr.P.Dakshina Murthy | Dr.V.R.K.Murthy | Dr.S.V.S.Ramana Reddy

Dr.R.Padmasuvarna | Dr.K.Samatha

Unit Outcomes:

The students will be able to

- **explain** the concept of polarization in dielectric materials.
- **summarize** various types of polarization of dielectrics .
- **interpret** Lorentz field and Claussius- Mosotti relation in dielectrics.
- **classify** the magnetic materials based on susceptibility and their temperature dependence.
- **explain** the applications of dielectric and magnetic materials .
- **Apply** the concept of magnetism to magnetic devices.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. "Engineering Physics" by M.R.Srinivasan, New Age international publishers (2009).
2. "Optics" by Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017.
3. "Solid State Physics" by A.J.Dekker, Mc Millan Publishers (2011).

1. Dr.G.Padmaja Rani	**Chairperson**
2. Dr.P.Dakshina Murthy	**Member**
3. Dr.V.R.K.Murthy	**External Member**
4. Dr.S.V.S.Ramana Reddy	**External Member**
5. Dr.K.Samatha	**External Member**
6. Dr.R.Padmasuvarna	**External Member**

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

L	T	P	C
3	0	0	3

I Year – II SEMESTER

PROBLEM SOLVING AND PROGRAMMIMG USING C

Submitted to the Principal, UCEK 28.06.2019

Problem Solving and Programming Using C

Objectives:

The objectives of this course are to make the student familiar with problem solving using computers, development of algorithms, usage of basic flowchart symbols and designing flowcharts.

The students can also understand programming language basic concepts, reading and displaying the data, earn the programming skills using selection, iterative control structures, functions, arrays, pointers and files. After completion of this course the student is expected to analyze the real life problem and write programs in C language to solve the problems.

Course Outcomes:

After completion of this course

- Student will be able to develop efficient algorithm for solving a problem.
- Use various constructs of C programming language efficiently.
- Student will be able to develop programs using modular approach such as functions. And also able to develop programs to perform matrix and mathematical applications.
- Student will be able to understand dynamic memory management and problems using pointers and solving the problems.
- Student will be able to develop programs for real life applications using structures and also learn about handling the files for storing the data permanently.

UNIT I: Problem Solving: Problem solving aspects, Problem solving techniques, Computer as a Problem solving tool, Algorithms-definition, features, criteria. Flowchart-definition, basic symbols, sample flowcharts. Top down design, Implementation of program verification, The efficiency of algorithms, Analysis of algorithms, computational complexity of algorithm, order(O) notation, Worst case & Average case Analysis.

UNIT II: Basics of C programming language: Introduction to C, structure of a C program, basic data types and sizes, constants, variables, unary, binary and ternary operators, expressions, type conversions, conditional expressions, precedence and order of evaluation, Input and Output statements, Sample Programs.

SELECTION-DECISION MAKING CONDITIONAL CONTROL STRUCTURES: simple-if, if-else, nested if-else, if-else ladder and switch-case.

ITERATIVE: while-loop, do-while loop and for loop control structures, goto, break and continue statements. Sample Programs.

L. Suracatty

28.06.2019

UNIT III: FUNCTIONS-basics, parameter passing, storage classes extern, auto, register, static, scope rules, block structure, user defined functions, standard library functions, recursive functions, Recursive solutions for Fibonacci series, towers of Hanoi, header files, C Preprocessor, example c programs

ARRAYS-concepts, declaration, definition, accessing elements, storing elements, 1-D arrays, 2-D arrays and character arrays, Multidimensional arrays, array applications: Matrix operations, checking the symmetricity of a Matrix, Passing 1-D arrays, 2-D arrays to functions, Strings and String Manipulations

UNIT IV: POINTERS-pointers concepts, initialization of pointer variables, pointers and function arguments, passing by address-dangling memory, address arithmetic, character pointers and functions, pointers to pointers, pointers and multi-dimensional arrays, dynamic memory management functions, command line arguments

UNIT V: ENUMERATED, STRUCTURE AND UNION TYPES: Derived types-structures- declaration, definition and initialization of structures, accessing structures, nested structures, arrays of structures, structures and functions, pointers to structures, self referential structures, unions, typedef, bit-fields, program applications

FILEHANDLING: Concept of a file, text files and binary files, Formatted I/O, File I/O operations

Text Books:

1. How to Solve it by Computer, R. G. Dromey, Pearson Education, 2019
2. Programming in C, Ashok N Kamthane, Amit Ashok Kamthane, 3rd Edition, Pearson Education, 2019

Reference Books:

1. The C programming Language by Dennis Richie and Brian Kernighan
2. Programming in C, Reema Thareja, OXFORD
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, Cengage

28.06.2019

R19 – UCEK – EEE Syllabus w.e.f 2019-20

I Year – II SEMESTER

L	T	P	C
3	0	0	3

ELECTRICAL CIRCUIT ANALYSIS – I

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	--	--	--	--	--	--	--	--	--	2	3	1
CO2	3	3	2	--	--	--	--	--	--	--	--	--	2	3	1
CO3	3	3	2	--	--	--	--	--	--	--	--	--	2	3	1
CO4	3	3	2	--	--	--	--	--	--	--	--	--	2	3	1
CO5	3	3	2	--	--	--	--	--	--	--	--	--	2	3	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I
Introduction to Electrical Circuits and Network topology

Basic Concepts of passive elements of R, L, C and their V-I relations, Sources (dependent and independent),Kirchoff's laws, Network reduction techniques(series, parallel, series - parallel, star-to-delta and delta-to-star transformation), source transformation technique, nodal analysis and mesh analysis.
Definitions of Graph and Tree, basiccutset and tieset matrices for planar networks, loop and nodal methods of analysis of networks with dependent and independent voltage and current sources, duality and dual networks.

UNIT-II
Magnetic Circuit

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

UNIT-III

Single Phase A.C Systems

Periodic waveforms (determination of rms, average value and form factor), concept of phase angle and phase difference – waveforms and phasor diagrams for lagging, leading networks, complex and polar forms of representations, steady state analysis of R, L and C circuits, powerfactor and its significance, real, reactive and apparent power, waveform of instantaneous power and complex power

UNIT-IV

Analysis of AC Networks

Extension of node and mesh analysis to AC networks, numerical problems on sinusoidal steady state analysis, series and parallel resonance, selectively band width and Quasi factor, introduction to locus diagram.

UNIT-V

Network theorems (DC & AC Excitations)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, Reciprocity theorem, Millman's theorem and compensation theorem.

Course Outcomes:

The Student should be able to solve

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

Text Books:

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

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India)
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications
3. Electric Circuits – (Schaum's outlines) by MahmoodNahvi& Joseph Edminister, Adapted by KumaRao, 5th Edition – McGraw Hill.
4. Electric Circuits by David A. Bell, Oxford publications
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthi,DhanpatRai&Co.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
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R19 – UCEK – EEE Syllabus w.e.f 2019-20

	L	T	P	C
I Year – II SEMESTER	**1**	**0**	**3**	**2.5**

ENGINEERING DRAWING

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (AUTONOMOUS)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA, KAKINADA
B.TECH (COMMON FOR CE,ECE,EEE,CSE,PE,PCE)
EFFECTIVE FROM 2019 BATCH

I BTech - II Semester

ENGINEERING DRAWING

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

Unit I

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

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

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

Scales: Plain scales, diagonal scales and vernier scales

Unit II

Objective: To introduce the students to use orthographic projections, projections of points & simple lines.

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.

Unit III

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

Part-A: Projections of straight lines inclined to both the planes.

Part-B: determination of true lengths of a line inclined to both the planes, angle of inclination and traces.

Unit IV

Objective: The objective is to make the students draw the projections of the plane inclined to both the planes and projections of Prism & Cylinder with axis inclined to one plane

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

Projections of Solids – Prisms & Cylinders with the axis inclined to one of the plane.

Unit V

Objective: The objective is to make the students draw the projections of the various types of solids in different positions inclined to one of the plane and 3D views to 2D and vice-versa

Pyramids & Cones with the axis inclined to one of the plane.

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

2/8/19

HEAD
Mechanical Engineering Department
University College of Engineering
J.N.T. University Kakinada
KAKINADA

UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (AUTONOMOUS)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA, KAKINADA
B.TECH (COMMON FOR CE,ECE,EEE,CSE,PE,PCE)
EFFECTIVE FROM 2019 BATCH

TEXT BOOKS:

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

REFERENCE BOOKS:

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

Course Outcome: After undergoing this course, the student learnt the scales, various engineering curves and drawing the 2D and 3D objects.

HEAD
Mechanical Engineering Departmen
University College of Engineering
J.N.T. University Kakinada
KAKINADA

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

I Year – II SEMESTER

L	T	P	C
0	0	3	1.5

ENGLISH COMMUNICATION SKILLS LAB - II

L	T	P	C
0	0	3	1.5

Semester-II

English Communication Skills Lab-II

TOPICS

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

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

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

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

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

References:

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

P. Rajendra Kamparkar 28/06/19

28/6/19

28/6/19

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

APLLIED PHYSICS LAB

APPLIED PHYSICS LAB

(Any 10 of the following listed 15 experiments)

LIST OF EXPERIMENTS:

1. Determination of wavelength of a source-Diffraction Grating-Normal incidence.
2. Newton's rings – Radius of Curvature of Plano - Convex Lens.
3. Determination of thickness of a spacer using wedge film and parallel interference fringes.
4. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
5. Energy Band gap of a Semiconductor p - n junction.
6. Characteristics of Thermistor – Temperature Coefficients
7. Determination of dielectric constant by charging and discharging method
8. Determination of resistivity of semiconductor by Four probe method.
9. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
10 Measurement of magnetic susceptibility by Quincke's method.
11. Dispersive power of diffraction grating.
12. Resolving Power of telescope
13. Resolving power of grating
14. Determination of Hall voltage and Hall coefficients of a given semiconductor using Hall effect.
15. Variation of dielectric constant with temperature.

1. Dr.G.Padmaja Rani	**Chairperson**	
2. Dr.P.Dakshina Murthy	**Member**	
3. Dr.V.R.K.Murthy	**External Member**	
4. Dr.S.V.S.Ramana Reddy	**External Member**	
5. Dr.K.Samatha	**External Member**	
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I Year – II SEMESTER

L	T	P	C
0	0	2	0

PHYSICS VIRTUAL LAB

APPLIED PHYSICS - VIRTUAL LAB – ASSIGNMENTS

(Constitutes 5 marks of 30 marks of Internal-component i.e,.Assignment component)

(Any 3 of the following listed 12 experiments)

LIST OF EXPERIMENTS

1. Hall Effect
2. Crystal Structure
3. Brewster's angle
4. Numerical Aperture of Optical fiber
5. Photoelectric Effect
6. LASER – Beam Divergence and Spot size
7. Michelson's interferometer
8. Black body radiation
9. Flywheel –moment of inertia
10. AC Sonometer
11. Resistivity by four probe method
12. Newton's rings –Refractive index of liquid

URL: www.vlab.co.in

1. Dr.G.Padmaja Rani	**Chairperson**	
2. Dr.P.Dakshina Murthy	**Member**	
3. Dr.V.R.K.Murthy	**External Member**	
4. Dr.S.V.S.Ramana Reddy	**External Member**	
5. Dr.K.Samatha	**External Member**	
6. Dr.R.Padmasuvarna	**External Member**	

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

PROBLEM SOLVING AND PROGRAMMING USING C LAB

Problem Solving and Programming using C Lab

Exercise 1

a) Write a C Program to calculate the area of a triangle.
b) Write a C program to find the largest of three numbers using ternary operator.
c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 2

a) Write a C program to find the 2's complement of a binary number.
b) Write a C program to find the roots of a quadratic equation.
c) Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 3

a) Write a C program to find the sum of individual digits of a positive integer and, also, find the reverse of the given number.
b) Write a C program to generate the first *n* terms of the Fibonacci sequence.
c) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 4

a) Write a C Program to print the multiplication table of a given number.
b) Write a C Program to read a decimal number and find its equivalent binary number.
c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 5

a) Write a C program to interchange the largest and smallest numbers in the given array.
b) Write a C program to implement a liner search on a given set of values.
c) Write a C program to implement binary search on a given set of values.

Exercise 6

a) Write a C program to implement sorting of an array of elements.
b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them.

Exercise 7

Write a C program that uses functions to perform the following operations:

i. To insert a sub-string into given main string at a given position.
ii. To delete n characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location.

Exercise 8

Write a C program that uses functions to perform the following operations using Structure:

i) Reading a complex number
ii) Writing a complex number
iii) Addition of two complex numbers
iv) Multiplication of two complex numbers

K. Kranti M.V. Subramanyam L. Suneelatha 28.06.2019

Exercise 9

Write C Programs for the following string operations without using the built in functions
- to concatenate two strings
- to append a string to another string
- to compare two strings

Exercise 10

a) Write C Program to find the number of characters in a given string including and excluding spaces.
b) Write C Program to copy the contents of one string to another string without using string handling functions.
c) Write C Program to find whether a given string is palindrome or not.
d) Write a C program to find both the largest and smallest number of an array of integers using call by value and call by reference.

Exercise 11

Write a C program using recursion for the following:
a) To display sum of digits of given number
b) To find the factorial of a given integer
c) To find the GCD (greatest common divisor) of two given integers.
d) To find Fibonacci sequence

Exercise 12

a) Write C Program to reverse a string using pointers
b) Write a C Program to compare two 2D arrays using pointers
c) Write a C program consisting of Pointer based function to exchange value of two integers using passing by address.

Exercise 13

Examples which explores the use of structures, union and other user defined variables

Exercise 14

a) Write a C program which copies one file to another.
b) Write a C program to count the number of characters and number of lines in a file.
c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

L. Suneelatty

28.06.2019

R19 – UCEK – EEE Syllabus w.e.f 2019-20

	L	T	P	C
I Year – II SEMESTER	**0**	**0**	**0**	**0.5**

ENGINEERING EXPLORATION PROJECT – DESIGN THINKING

Engineering Exploration Project – Design Thinking
(Common for CE, EEE, ME, ECE, & CSE)

(15 Hrs per Sem.)

COURSE OBJECTIVES:

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

Apply Design Thinking on the following Streams to

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

HOW TO PURSUE THE PROJECT WORK?

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

TASKS TO BE DONE:

Task 1: Everyone is a Designer

- Understand class objectives & harness the designer mindset

Task 2: The Wallet/Bag Challenge and Podcast

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

Task 3: Teams & Problems

- Start Design Challenge and learn about teams & problems through this

- Foster team collaboration, find inspiration from the environment and learn how to identify problems

Task 4: Empathizing

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

Task 5: Ideating

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

Task 6: Prototyping

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

Task 7: Testing

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

Task 8:

- Final Report Submission and Presentation

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

REFERENCES:

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

OTHER USEFUL DESIGN THINKING FRAMEWORKS AND METHODOLOGIES:

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

SOME SAMPLE TEMPLATES

Note: These are sample templates but can be augmented with other relevant templates for evaluating the students performance.

Activity Card: Empathize (Use six hat thinking)	
What emotions might the user be feeling?	What does the user say or do?
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
What are some advices / comments which the user hears from his friends or relatives?	What does the user see?
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.
Positives & Negatives	Best Solution

Activity Card: Design Challenge		
Research / Observe List the specific facts and observations that you noticed in the scenario. 1.	Define Challenges Write down all the problems which are relevant and can be addressed.	
	Challenge 1:	Challenge 2:
	Challenge 3:	Challenge 4:
	Challenge 5:	Challenge 6:

Activity Card : Ideate Arriving at the right design					
Ideas Generated	Uniqueness	Ease of use	Ease of Design	Durability	Feasibility

Activity Card: Abstract Prototype
Abstract – Rough Sketch of the Prototype

Activity Card : Concrete Prototype
Concrete- Detailed Sketch of the Prototype
Material Required & Specifications
1
2
3
4
5
6
7
8
9
10
Activity Card: Test - Questions

User Testing Questions	
User Testing Questions	Remarks
1. What do you like and dislike about this prototype?	
2. What could be done to make "you want" to use this prototype more?	
3. What do you think of how the prototype looks (the aesthetics)?	
4. Is the prototype efficient safe and comfortable to use? If not how could it be improved to make it user friendly?	
5. What are the problems with this prototype?	
6. What can done to solve these problems?	

Activity Card: Test Observations
USER TESTING OBSERVATIONS
Observations
1. What does the user do with this prototype?
2. What are the user's perceptions of the prototype?
3. How successful or unsuccessful does the user think the prototype is?
4. How does it meet or fail the user's needs?
5. How safe is the prototype?

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

I Year – II SEMESTER

L	T	P	C
3	0	0	0

CONSTITUTION OF INDIA

Course Objectives:

- To Enable the student to understand the importance of constitution
- To understand the structure of executive, legislature and judiciary
- To understand philosophy of fundamental rights and duties
- 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.
- To understand the central and state relation financial and administrative.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	--	2	--	--	2	2	--	2	--	--	2	--	--	1
CO2	--	--	3	--	--	3	3	--	3	--	--	2	--	--	1
CO3	--	--	3	--	--	3	3	--	3	--	--	2	--	--	1
CO4	--	--	2	--	--	2	2	--	2	--	--	1	--	--	1
CO5	--	--	3	--	--	3	3	--	3	--	--	3	--	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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.

Learning outcomes:

After completion of this unit student will

- Understand the concept of Indian constitution
- Apply the knowledge on directive principle of state policy
- Analyze the History, features of Indian constitution
- Evaluate Preamble Fundamental Rights and Duties

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, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions;

Learning outcomes:-After completion of this unit student will

- Understand the structure of Indian government
- Differentiate between the state and central government
- Explain the role of President and Prime Minister
- Know the Structure of supreme court and High court

UNIT-III

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

Learning outcomes:-After completion of this unit student will

- Understand the structure of state government
- Analyze the role Governor and Chief Minister
- Explain the role of state Secretariat
- Differentiate between structure and functions of state secretariat

UNIT-IV

A.Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, 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

Learning outcomes:-After completion of this unit student will

- Understand the local Administration
- Compare and contrast district administration role and importance
- Analyze the role of Myer and elected representatives of Municipalities
- Evaluate Zillapanchayat block level organisation

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

Learning outcomes:-After completion of this unit student will

- Know the role of Election Commission apply knowledge

- Contrast and compare the role of Chief Election commissioner and Commissiononerate
- Analyze role of state election commission
- Evaluate various commissions of viz SC/ST/OBC and women

References:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. 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:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Outcomes:

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

1. Understand historical background of the constitution making and its importance for building a democratic India.
2. Understand the functioning of three wings of the government ie., executive, legislative and judiciary.
3. Understand the value of the fundamental rights and duties for becoming good citizen of India.
4. Analyze the decentralization of power between central, state and local self-government.
5. 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

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II Year – I SEMESTER

L	T	P	C
3	0	0	3

ELECTRONIC DEVICES AND CIRCUITS

Course Objectives:

- To learn and understand the basic concepts of semiconductor physics.
- Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of different diodes.
- To learn and understand the application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
- Acquire knowledge about the principle of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics.
- To learn and understand the purpose of transistor biasing and its significance.
- Small signal equivalent circuit analysis of BJT and FET transistor amplifiers and compare different configurations.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	3	--	--	--	--	--	--	--	--	--	--	--	--	2
CO2	2	--	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3	--	--	--	--	2	--	--	--	--	--	--	--	1	--	--
CO4	--	--	--	1	--	--	--	--	--	--	--	--	--	2	--
CO5	1	--	2	--	--	--	--	--	--	--	--	--	--	--	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I: Review of Semi-Conductor Physics: Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

Junction Diode Characteristics : energy band diagram of PN junction Diode, 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.

UNIT-II:

Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, UJT, PNPN Diode, SCR. Construction, operation and V-I characteristics.

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(Series inductor), Capacitor filter(Stunt inductor), π-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, characteristicsμ, g_m, r_d parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

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

FET Biasing- methods and stabilization.

UNIT- V: Small Signal Low Frequency Transistor Amplifier Models:
BJT: Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of transistor amplifiers.
FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.

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

- Apply the basic concepts of semiconductor physics.
- Understand the formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation.
- Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
- Understand the construction, principle of operation of transistors, BJT and FET with their V-I characteristics in different configurations.
- Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.
- Perform the analysis of small signal low frequency transistor amplifier circuits using BJT and FET in different configurations.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, SecondEdition,2007
2. Electronic Devices and Circuits by David A. Bell, Oxford University Press
3. Electronics devices & circuit theory- Robert L.Boylestad and LouiNashelsky, Pearson/Prentice hall, tenth edition,2009

References:

1. Integrated Electronics-J. Millman, C. Halkias,Tata Mc-Graw Hill, Second Edition,2009
2. Electronic Devices and Circuits-K. Lal Kishore, BS Publications, Fourth Edition,2016.
3. Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, 4th Edition,2008.
4. Electronic Devices and Integrated Circuits – B.P. Singh,Rekha , Pearson publications, 2006.

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II Year – I SEMESTER

L	T	P	C
2	0	0	2

THERMAL AND HYDRO PRIME MOVERS

Part-A: Thermal prime movers

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

UNIT I:

Objectives: To make the student learn about the constructional features, operational details of various types of internal combustion engines through the details of several engine systems and the basic air standard cycles, that govern the engines.

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

UNIT II:

Objectives: To train the student in the aspects of steam formation and its utilities through the standard steam data tables and charts. To make the student understand the working of steam turbines.

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.

Steam Turbines: Schematic layout of steam power plant - Classification of Steam Turbines-Impulse Turbine and Reaction Turbine.

UNIT III:

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

Gas Turbines: Simple gas turbine plant-ideal cycle, closed cycle -open cycle-. Efficiency, Work ratio and optimum pressure ratio for simple gas turbine cycle.

Part-B: Hydro prime movers

UNIT IV:

Objectives: To impart the knowledge of various types of pumps, their constructional features, working. To make the student learn about the constructional features, operational details of various types of hydraulic turbines.

PUMPS: Types of pumps, Centrifugal pumps: Main components, working principle.

HYDRAULIC TURBINES: Classification of turbines; Working principle, Efficiency calculation and working `principles for Pelton Wheel, Francis and for Kaplan turbines; Governing of turbines.

UNIT V:

Objectives: To train the student in the areas of types of hydro electric power plants, estimation and calculation of different loads by considering various factors.

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

TEXT BOOKS:

1. Thermal Engineering by Rajput,Lakshmi publications
2. Thermal engineering by M.L.Mathur and F.S.Mehta, Jain Brothers.
3. Hydraulics & Fluid Mechanics, P.N. Modi and S.M. Seth, Standard Book House, Delhi

REFERENCE BOOKS:

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

Course outcomes:

CO1: Air standard cycles, constructional & operational details of I.C Engines.
CO2: Properties of steam, Rankine cycle, principle and working of steam turbines.
CO3: Fundamentals, governing cycle, working and efficiency of gas turbines.
CO4: Working principle of pumps and hydraulic turbines.
CO5: Details and working of Hydro electric power plants and various loads.

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

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II Year – I SEMESTER

L	T	P	C
3	0	0	3

DIGITAL ELECTRONICS

Course Objectives:

- To solve a typical number base conversion and analyze new error coding techniques.
- Theorems and functions of Boolean algebra and behavior of logic gates.
- To optimize logic gates for digital circuits using various techniques.
- Boolean function simplification using Karnaugh maps and Quine-McCluskey methods.
- To understand concepts of combinational circuits.
- To develop advanced sequential circuits.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	-	-	-	-	-	-	2	3	1
CO2	3	2	3	2	1	3	-	-	-	-	-	-	2	3	1
CO3	3	2	3	2	1	3	-	-	-	-	-	2	2	3	1
CO4	3	2	3	2	1	3	-	-	-	-	-	3	2	3	1
CO5	3	2	3	2	1	3	-	-	-	-	-	2	2	3	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT – I

REVIEW OF NUMBER SYSTEMS & CODES:

Representation of numbers of different radix, conversation from one radix to another radix, r-1's compliments and r's compliments of signed members.Gray code ,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc., Error detection & correction codes: parity checking, even parity, odd parity, Hamming code

Boolean theorems and logic operations

Boolean theorems, principle of complementation & duality, De-morgan theorems.Logic operations ; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX-NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations.

UNIT – II

MINIMIZATION TECHNIQUES:

Minimization and realization of switching functions using Boolean theorems, K-Map (up to 6 variables) and tabular method.

COMBINATIONAL LOGIC CIRCUITS DESIGN

Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit

UNIT – III

COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI :

Design of encoder ,decoder, multiplexer and demultiplexers, Implementation of higher order circuits using lower order circuits . Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder..

INTRODUCTION OF PLD's :
PLDs:PROM, PAL, PLA -Basics structures, realization of Boolean functions.

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

UNIT – V
SEQUENTIAL CIRCUITS II :
Finite state machine; state diagrams, state tables, reduction of state tables. Analysis of clocked sequential circuits Mealy to Moore conversion and vice-versa. Realization of sequence generator and sequence detector circuits.

Course Outcomes:
The Student should be able to:

- Classify different number systems, generate various codes and use the concept of Boolean algebra in minimization of switching functions.
- Simplify switching functions by applying the knowledge of K-map/tabulation methods and able to design the arithmetic combinational circuits.
- Design different types of combinational logic circuits at LSI/MSI level.
- Know the operation of various flip-flops and apply knowledge of flip-flops in designing of registers and counters.
- Reduce state tables, analyze synchronous sequential circuits and apply different methods for the design of synchronous sequential circuits.

TEXT BOOKS:
1. Switching and finite automata theory Zvi.KOHAVI 3RD EDITION
2. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers
3. Digital Design by Mano PHI.

REFERENCES:
1. Switching Theory and Logic Design by A. Anand Kumar
2. Switching Theory and Logic Design by Hill and Peterson Mc-Graw Hill TMH edition

II Year – I SEMESTER

L	T	P	C
3	0	0	3

ELECTRICAL CIRCUIT ANALYSIS-II

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	--	--	--	--	--	--	--	--	2	3	1
CO2	3	3	2	2	--	--	--	--	--	--	--	--	2	3	1
CO3	3	3	2	2	--	--	--	--	--	--	--	--	2	3	1
CO4	3	3	2	2	--	--	--	--	--	--	--	--	2	3	1
CO5	3	3	2	2	--	--	--	--	--	--	--	--	2	3	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

UNIT-III Transient Analysis in AC circuits

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

UNIT-IV 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-V 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.

Course Outcomes:

The Student should be able to:

- Solve three- phase circuits under balanced and unbalanced condition
- Find the transient response of electrical networks for different types of excitations.
- Find parameters for different types of network.
- Realize electrical equivalent network for a given network transfer function.
- Analyze electrical circuits using applications of Fourier series and Fourier transforms.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company,6 th edition
2. Network synthesis: Van Valkenburg: Prentice-Hall of India Private Ltd.
3. Electric circuit analysis by Joseph Edminister, schaum's outlines series

Reference Books:

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

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

II Year – I SEMESTER

L	T	P	C
3	0	0	3

ELECTRICAL MACHINES – I

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

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	-	1	-	-	-	-	1	2	2	2	2
CO2	3	2	2	2	-	1	-	-	-	-	1	3	3	2	2
CO3	3	3	2	2	-	1	-	-	-	-	1	3	3	3	2
CO4	3	3	2	2	-	1	-	-	-	-	1	3	3	3	2
CO5	3	3	2	2	-	1	-	-	-	-	1	3	3	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT–I:
Electromechanical Energy Conversion and introduction to DC machines
Principles of electromechanical energy conversion - singly excited and multi excited systems-calculation of force and torque using the concept of co-energy**.**
Construction and principle of operation of DC machines – EMF equation for generator – Excitation techniques– characteristics of DC shunt generator –applications of DC Generators

UNIT–II:
Operation of DC motors
Back-emf and torque equations of dc motors – Armature reaction and commutation – characteristics of separately-excited, shunt, series and compound motors – losses and efficiency – applications of dc motors.
Necessity of a starter – starting by 3 point and 4 point starters.

UNIT-III:
Speed Control of motors and Testing of DC Machines
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 – field's test- separation of losses.
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.

UNIT-IV

Performance and testing of transformers and auto transformers:

Regulation – losses and efficiency – effect of variation of frequency and supply voltage on losses – all day efficiency.

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.

UNIT-V

3-Phase Transformer:

Polyphase connections- Y/Y, Y/ Δ, Δ/Y, Δ/ Δ and open Δ- third harmonics in phase voltages – three winding transformers- transients in switching –off load and on load tap changers- Scott connection.

Course outcomes:

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

- Understand the unifying principles of electromagnetic energy conversion, construction, principle of operation of DC machines
- Understand Armature reaction and commutation principles of DC machines and illustrate the characteristics of DC motors
- Illustrate speed control methods and testing methods of DC machines. Develop the equivalent circuit of a single-phase transformer
- Apply testing methods for performance evaluation of single-phase transformer and describe the operation of autotransformer
- Analyze the effect of harmonics in three-phase transformers and understand the functioning of off-load and on-load tap changers, Scott connection.

Text Books:

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

Reference Books:

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

II Year – I SEMESTER

L	T	P	C
3	0	0	3

ELECTROMAGNETIC FIELDS

Preamble:

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

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	2	1	1	2	2	3	2	3	2	3
CO2	2	2	2	2	2	2	2	1	2	2	2	3	2	2	2
CO3	3	3	2	3	3	2	2	2	2	2	2	2	3	3	3
CO4	2	2	2	3	2	2	2	2	2	2	2	2	2	2	2
CO5	3	2	2	3	2	3	2	2	2	2	2	2	2	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

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 — potential gradient, Gauss'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 behaviour in electric field.

Polarization, boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space. 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 and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Maxwell's second Equation(div(B)=0), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, 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:
Faraday's laws of electromagnetic induction – its integral and point forms, Maxwell's fourth equation(Curl (E)=-∂B/∂t), statically and dynamically induced EMF –, modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

UNIT – V Time Varying Fields:
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.

Course outcomes:
The student should be able to:

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

Text Books:

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

Reference Books:

1. " Principles of Electro Magnetics" by Sadiku, Oxford Publications,4th edition
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd edition

3. "Electromagnetic Field Theory" by YaduvirSingh,Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford higher Education.

II Year – I SEMESTER

L	T	P	C
3	0	0	3

POWER SYSTEMS-I

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

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	3	--	--	--	--	--	1	--	1	2	3	3
CO2	2	1	1	3	--	--	--	--	--	1	--	1	2	3	3
CO3	2	3	2	2	--	--	--	--	--	1	--	1	2	3	3
CO4	2	2	2	3	--	--	2	--	--	1	--	1	2	3	3
CO5	2	2	2	2	--	--	2	--	--	1	--	1	2	3	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

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 and 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 substation.

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

- Identify the different components of thermal power plants.
- Identify the different components of nuclear Power plants.
- Identify the different components of air and gas insulated substations.
- Identify single core and three core cables with different insulating materials.
- Analyse the different economic factors of power generation and tariffs.

Text Books:

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

Reference Books:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi.

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II Year – I SEMESTER

L	T	P	C
0	0	3	1.5

ELECTRICAL CIRCUITS LAB

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	-	-	-	2	1	1	2	3	2	2
CO2	3	3	2	2	1	-	-	-	2	1	1	2	3	2	2
CO3	3	2	2	2	1	-	-	-	2	1	1	2	3	2	2
CO4	3	2	2	1	1	-	-	-	2	1	1	1	2	2	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

Any 10 of the following experiments are to be conducted:

1) Verification of Kirchhoff's circuit laws.
2) Verification of Thevenin's and Norton's Theorems
3) Verification of superposition theorem and maximum power transfer theorem
4) Verification of compensation theorem
5) Verification of reciprocity and Millmann's Theorems
6) Locus diagrams of RL and RC series circuits
7) Series and parallel resonance
8) Determination of self, mutual inductances and coefficient of coupling
9) Determination of impedance (Z) and Admittance (Y) Parameters
10) Determination of Transmission and hybrid parameters
11) Determination of Parameters of a choke coil.
12) Determination of cold and hot resistance of an electric lamp.
13) Measurement of 3-phase power by two Wattmeter method for unbalanced loads
14) Determination of RMS and average value of non-sinusoidal wave forms.

Course outcomes:

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

- Apply Thevenin's, Norton's, Thevenin's, superposition theorem, maximum power transfer, compensation, reciprocity and Millmann's Theorems to compare practical results obtained with theoretical calculations
- Draw locus diagrams of RL, RC series circuits and examine series and parallel resonance
- Determine self, mutual inductances and coefficient of coupling values, parameters of choke coil, Z, Y, Transmission and hybrid parameters.
- Calculate power consumed by balanced and unbalanced loads

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L	T	P	C
0	0	2	1

THERMAL AND HYDRO LAB

Note: Please collect the syllabus from concerned Department BOS
Course Objective: To impart practical knowledge on the performance evaluation methods of various internal combustion engines, flow measuring equipment and hydraulic turbines and pumps.

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

SECTION A - THERMAL ENGINEERING LAB

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

SECTION B – HYDRAULIC MACHINES LAB

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

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II Year – I SEMESTER

L	T	P	C
3	0	0	0

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Note: Please collect the syllabus from concerned Department BOS

II Year – I SEMESTER

L	T	P	C
3	0	0	0

EMPLOYABILITY SKILLS-I

COURSE OUTCOMES: The end of the course student will be able to

CO	Course Outcomes	Knowledge Level (K)#
CO1	Understand the corporate etiquette.	K2
CO2	Make resentations effectively with appropriate body language	K3
CO3	Be composed with positive attitude	K3
CO4	Understand the core competencies to succeed in professional and personal life	K2

 # Based on suggested Revised BTL

UNIT – I:

1. Analytical Thinking & Listening Skills: Self-Introduction, Shaping Young Minds - A Talk by Azim Premji (Listening Activity), Self – Analysis, Developing Positive Attitude, Perception.

2. **Communication Skills**: Verbal Communication; Non Verbal Communication (Body Language)

UNIT – II:

3. Self-Management Skills: Anger Management, Stress Management, Time Management, Six Thinking Hats, Team Building, Leadership Qualities

4. Etiquette: Social Etiquette, Business Etiquette, Telephone Etiquette, Dining Etiquette

UNIT – III

5. Standard Operation Methods: Note Making, Note Taking, Minutes Preparation, Email & Letter Writing

6 Verbal Ability: Synonyms, Antonyms, One Word Substitutes-Correction of Sentences-Analogies, Spotting Errors, Sentence Completion, Course of Action -Sentences Assumptions, Sentence Arguments, Reading Comprehension, Practice work

UNIT-IV:

7. Job-Oriented Skills –I: Group Discussion, Mock Group Discussions

8. Job-Oriented Skills –II: Resume Preparation, Interview Skills, Mock Interviews

Text books and Reference books:

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

E-resources:

1. www. Indiabix.com
2. www.freshersworld.com

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II Year – II SEMESTER

L	T	P	C
3	0	0	3

SIGNALS AND SYSTEMS

Course Objectives:

- To study about signals and systems.
- To analyze the spectral characteristics of signal using Fourier series and Fourier Transforms.
- To understand the characteristics of systems.
- To introduce the concept of sampling process
- To know various transform techniques to analyze the signals and systems.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	--	--	--	--	--	--	--	--	--	2	2	2
CO2	1	2	2	--	--	--	--	--	--	--	--	--	2	2	2
CO3	2	2	2	2	1	--	--	--	--	--	--	--	2	2	2
CO4	--	2	2	1	--	--	--	--	--	--	--	--	2	2	2
CO5	3	3	3	--	--	--	--	--	--	--	--	--	2	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

UNIT –II: FOURIER SERIES AND FOURIER TRANSFORM:
Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum. Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform. Related Problems.

UNIT-III: ANALYSIS OF LINEAR SYSTEMS: Introduction**,** Linear system, impulse response, Response of a linear system, Linear time invariant (LTI) system, Linear time variant (LTV) system, Concept of convolution in time domain and frequency domain, Graphical representation of convolution, Transfer function of a LTI system, Related problems. Filter characteristics of linear systems. Distortion less transmission through a system, Signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time.

UNIT –IV:

CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between Convolution and correlation, Detection of periodic signals in the presence of noise by correlation, Extraction of signal from noise by filtering.

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

UNIT –V:

LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L.T's, Inverse Laplace transform, Relation between L.T's, and F.T. of a signal. Laplace transform of certain signals using waveform synthesis.

Z–TRANSFORMS: Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms. Distinction between Laplace, Fourier and Z transforms.

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

- Differentiate the various classifications of signals and systems
- Analyze the frequency domain representation of signals using Fourier concepts
- Classify the systems based on their properties and determine the response of LTI Systems.
- Know the sampling process and various types of sampling techniques.
- Apply Laplace and z-transforms to analyze signals and Systems (continuous & discrete).

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn,1997
3. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition,2007

REFERENCE BOOKS:

1. Principles of Linear Systems and Signals – BP Lathi, Oxford University Press, 2015
2. Signals and Systems – T K Rawat , Oxford University press, 2011

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II Year – II SEMESTER

L	T	P	C
3	0	0	3

MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS

Course Objectives:

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

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
1	--	--	1	--	--	2	3	--	--	--	--	--	3	--	--
2	2	--	3	3	2	--	--	--	--	--	--	--	2	1	--
3	--	3	2	1	2	--	--	--	--	--	--	--	1	--	--
4	--	2		2	--	3	--	--	--	--	--	--	3	1	--
5	--	3	2	1	2	--	--	--	--	--	--	--	2	3	--

Unit-I

Introduction to Managerial Economics and demand Analysis:

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

Unit – II:

Theories of Production and Cost Analyses:

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

Unit – III:

Introduction to Markets, Theories of the Firm & Pricing Policies:

Market Structures: Perfect Competition, Monopoly, Monopolistic competition and Oligopoly – Features – Price and Output Determination – Managerial Theories of firm: Marris and Williamson's models – other Methods of Pricing: Average cost pricing, Limit Pricing, Market Skimming Pricing, Internet Pricing: (Flat Rate Pricing, Usage sensitive pricing) and Priority Pricing, Business Cycles :

Meaning and Features – Phases of a Business Cycle. Features and Evaluation of Sole Trader, Partnership, Joint Stock Company – State/Public Enterprises and their forms.

Unit – IV:

Introduction to Accounting & Financing Analysis:

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

Unit – V:

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

Course Outcome:

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

REFERENCES:

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

Course Outcome:

CO1: Learner equipped with the knowledge of demand, supply analysis and estimating Demand elasticity, demand forecasting and Law of Supply

CO2: Learner is able to knowledge of understanding the production, Production function, Input-Output-cost relationships and estimation of the lease cost combination of inputs.

CO3: One is also ready to understand the nature of different markets and price-output determination under various Market conditions have a knowledge of Pricing Methods and to know the various Business Organizations and Business Cycles.

CO4: Learner is able to prepare financial statements and the usage of various Accounting tools for analysis.

CO5: Student equipped to evaluate the various investment project proposals with the help of Capital Budgeting techniques for decision making.

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

R19 – UCEK – EEE Syllabus w.e.f 2019-20

II Year – II SEMESTER

L	T	P	C
3	0	0	3

ELECTRICAL MACHINES – II

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

Course objectives:
- Understand the principle of operation and performance of 3-phase induction motor.
- Quantify the performance of induction motor and induction generator in terms of torque and slip.
- To understand the torque producing mechanism of a single phase induction motor.
- To understand the performance analysis of synchronous generators, parallel operation and control of real and reactive powers.
- To understand the operation, performance and starting methods of synchronous motors.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	--	--	--	--	--	--	--	--	3	3	1	1
CO2	3	3	1	--	--	--	--	--	--	--	--	3	3	1	1
CO3	3	3	1	--	--	--	--	--	--	--	--	3	3	1	1
CO4	3	3	1	--	--	--	--	--	--	--	--	3	3	1	1
CO5	3	3	1	--	--	--	--	--	--	--	--	3	3	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I
3-Phase Induction Motors

Construction details of squirrel cage and slip ring induction motors – production of rotating magnetic field – principle of operation – Equivalent circuit –phasor diagram- slip speed-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.

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 – induction generator operation (Qualitative treatment only)

UNIT – III:

Starting Methods of 3-Phase Induction Motors And Single Phase Induction Motors

Methods of starting of three phase Induction motors- starting current and torque. Single phase induction motors- constructional features- equivalent circuit- problem of starting-double revolving field theory- Methods of starting.

AC series motors.

UNIT–IV:

Construction, Operation, Voltage Regulation And Parallel Operation Of Synchronous Generator:

Constructional features of non-salient and salient pole machines –types of armature 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:

- Explain the operation and performance of three phase induction motor.
- Analyze the torque-speed relation, performance of induction motor and induction generator.
- Implement the starting of single phase induction motors.
- Develop winding design and predetermine the regulation of synchronous generators.
- Explain hunting phenomenon, implement methods of staring and correction of power factor with synchronous motor.

Text Books:

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

Reference Books:

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

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

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

CONTROL SYSTEMS

Preamble :

This course introduces the elements of linear control systems and their analysis. This course covers classical methods of design using frequency response, state space approach for modeling and analysis of LTI systems.

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	-	-	-	-	-	-	1	2	2	2	2
CO2	3	3	2	2	1	-	-	-	-	-	1	3	3	2	2
CO3	3	3	3	3	1	-	-	-	-	-	1	3	3	3	2
CO4	3	3	3	3	1	-	-	-	-	-	1	3	3	3	2
CO5	2	2	2	2	1	-	-	-	-	-	1	3	2	2	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT – I:

Mathematical modeling of control systems

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

UNIT-II:

Time response analysis

Standard test signals – time response of first and second order systems – time domain specifications, steady state errors and error constants, effects of proportional (P), proportional integral (PI), proportional integral derivative (PID) systems.

UNIT–III:

Stability Using R-H Criterion

The concept of stability – Routh's stability criterion – limitations of Routh's stability.

Stability Using Root locus technique

Root locus concept – construction of root loci (simple problems), Effect of addition of Poles and zeros to the transfer function.

UNIT–IV:

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–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:

- Derive the transfer function of physical systems and determine overall transfer function using block diagram algebra and signal flow graphs.
- Evaluate the time response of first and specifications of second order systems and determine error constants.
- Analyze the absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
- Analyze the stability of LTI systems using frequency response methods.
- Apply state space analysis concepts to represent physical systems as state models, derive transfer function and determine the response. Understand the concepts of controllability and observability.

Text Books:

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

Reference Books:

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

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II Year –II SEMESTER

L	T	P	C
3	0	0	3

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Preamble:

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

Course objectives:

- To study the principle of operation and working of different types of instruments for measurement of electrical quantities.
- To study the working principle of operation of different types of instruments for measurement of power and power factor.
- To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
- To understand the principle of operation and working of transducers.
- To study the principle of operation and working of DVMS, power analyzer and applications of CRO.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO2	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO3	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO4	1	2	3	--	1	--	--	--	--	--	--	--	1	2	--
CO5	1	2	3	--	1	--	--	--	--	--	--	--	1	2	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT–I:

Analog ammeter and voltmeters

Classification – deflecting, control and damping torques– PMMC, Moving iron type, electrostatic instruments, construction, torque equation, range extension, effect of temperature, errors and compensations, advantages and disadvantages. Instrument transformers: Current transformer and Potential transformer-construction, theory errors, numerical problems.

UNIT –II:

Analog watt meters and power factor meters

Electrodynamometer type wattmeter (LPF and UPF), power factor meters: Dynamometer and M.I. type (single phase and three phase), construction, theory, torque equation, advantages and disadvantages – Numerical problems.

UNIT – III:

Measurements of Electrical parameters

DC Bridges: Method of measuring low, medium and high resistance – sensitivity of Wheat stone's bridge, Kelvin's double bridge for measuring low resistance, Loss of charge method

for measurement of high resistance, megger – measurement of earth resistance– Numerical problems.

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

UNIT – IV:

Transducers:

Definition, classification, resistive , inductive, and capacitive transducer, LVDT, straingauge, Thermistors, thermo-couples, Pieozo electric, Hall effect sensors, Flow meters, Measurement of pressure- Numerical problems

UNIT – V:

Digital meters

Digital voltmeter– successive approximation, DVM, ramp type DVM and integrating type DVM- Digital frequency meter, digital multi meter, digital tachometer, digital energy meter, LCR-Q meter, Power Analyzer, CRO- Block diagram, operation, equation for deflection, measurement of phase difference, frequency, hysteresis loop, Lissajious patterns in CRO- Numerical Problems.

Course Outcomes:

The student should be able to:

- Choose right type of instrument for measurement of ac and dc Electrical quantities.
- Choose right type of instrument for measurement of power and power factor
- Select right type for measurement of R,L,C.
- Understand the effectiveness of transducer.
- Able to understand digital meter.

Text Books:

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

Reference Books:

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

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

ELECTRICAL MACHINES – I LABORATORY

Course objectives:

- To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
- To control the speed of DC motors.
- To predetermine the performance of DC machines.
- To predetermine the efficiency and regulation of transformers and assess their performance.
- To realize 2-Ø supply from 3-Ø supply using Scott connection and understand parallel operation of transformers

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	-	-	2	1	1	2	3	3	2
CO2	3	2	2	2	-	-	-	-	2	1	1	2	3	2	2
CO3	3	3	2	2	-	-	-	-	2	1	1	2	3	3	2
CO4	3	2	2	1	-	-	-	-	2	1	1	1	2	2	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

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. Determination of equivalent circuit and predetermination of efficiency and regulation.
9. Sumpner's test on single phase transformers. Determination of equivalent circuit and predetermination of efficiency and regulation.
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:

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

- Analyze the performance of DC motor and generator by conducting different tests
- Understand the characteristics of DC generator and demonstrate the speed control of motors
- Determine the efficiency and regulation of transformers and assess their performance by conducting different tests
- Produce 2-Ø supply from 3-Ø supply using Scott connection and understand parallel operation of transformers

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

ELECTRONIC DEVICES & CIRCUITS LAB

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO1	PSO2	PSO3
CO1	2	--	--	--	--	--	--	--	--	--	--	--	2	--	--
CO2	--	--	2	--	--	--	--	--	--	--	--	--	--	--	2
CO3	--	--	--	--	2	--	--	--	--	--	--	--	1	--	--
CO4	--	2	--	--	--	--	--	--	--	--	--	--	--	2	--
CO5	--	2	--	--	--	--	--	--	--	--	--	--	--	--	1
CO6	1	--	1	--	2	--	--	--	--	--	--	--	1	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Electronic Workshop Practice:

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

.

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

1. P-N Junction Diode Characteristics
2. Part A: Germanium Diode (Forward bias& Reverse bias)Part B: Silicon Diode (Forward Bias only)
3. Zener Diode CharacteristicsPart A: V-I Characteristics
    i. Part B: Zener Diode as Voltage Regulator
4. Rectifiers (without and with c-filter) Part A: Half-wave Rectifier
    i. Part B: Full-wave Rectifier
5. BJT Characteristics(CE Configuration)Part A: Input Characteristics
6. Part B: Output Characteristics

7. FET Characteristics(CS Configuration) Part A: Drain Characteristics Part B: Transfer Characteristics
8. SCR Characteristics
9. UJT Characteristics
10. Transistor Biasing
11. CRO Operation and its Measurements
12. BJT-CE Amplifier
13. Emitter Follower-CC Amplifier FET-CS Amplifier

Equipment required:

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

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	L	T	P	C
II Year – II SEMESTER	**0**	**0**	**2**	**1**

ELECTRICAL SIMULATION LABORATORY

Course Objectives:

- To understand MATLAB/SIMULINK.
- To distinguish between time domain and frequency domain analysis.
- To control the speed of DC motors.
- To simulate Electrical Network Theorems.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	2	3	--	--	--	3	3	--	--	3	3	3
CO2	1	--	2	2	3	--	--	--	3	3	--	--	3	3	3
CO3	1	--	2	2	3	--	--	--	3	3	--	--	3	3	3
CO4	1	--	2	2	3	--	--	--	3	3	--	--	3	3	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any 10 of the following experiments are to be conducted

1. Fundamentals of MATLAB/SMULINK.
2. Generation of various signals and sequences (Periodic and Aperiodic), such as unit Impulse, Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
3. Operations on signals and sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy, and Average Power
4. Mesh and Nodal Analysis of Electrical circuits
5. Application of Network Theorems to Electrical Networks
6. Waveform Synthesis using Laplace Transform
7. Harmonic analysis of non-sinusoidal waveform
8. Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum
9. Design and simulate the characteristics of first and second order circuits in
   (i) Time and (ii) Frequency domain using Pspice.
10. Simulation of three phase bridge rectifier using Pspice.
11. DC Motor Speed control using MATLAB/Simulink
12. Design and analyse the performance of feedback control system
13. Simulate and tune parameters of a PID controller for a given system

Course Outcomes:

The students should able to

- Simulate Electrical network theorems.
- Simulate speed control of DC Motor.
- Simulate and analyze electrical and electronic circuits.
- Model, simulate and analyze the performance of DC Machines.

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

PROFESSIONAL ETHICS AND HUMAN VALUES

Note: Please collect the syllabus from concerned Department BOS

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	L	T	P	C
II Year – II SEMESTER	**0**	**0**	**1**	**0.5**

SOCIALLY RELEVANT PROJECTS- I

SOCIALLY RELEVANT PROJECTS

(15 HRS)

1. Water Conservation Related Works
2. Swatch Bharath (Internal External)
3. Helping police
4. Traffic monitoring
5. Teaching Rural Kids (Sarva siksha Abhiyan)
6. Street light monitoring
7. Electricity Conservation
8. Solar panel utilization
9. E- policing & cyber solution
10. Pollution
11. Any social related

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III Year – I Semester

L	T	P	C
3	0	0	3

POWER SYSTEMS-II

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	1	2	-	-	-	-	-	-	1	3	1
CO2	3	2	3	2	1	3	-	-	-	-	-	2	1	3	1
CO3	3	2	3	2	1	2	-	-	-	-	-	3	1	3	2
CO4	3	2	3	2	1	2	-	-	-	-	-	2	1	3	1
CO5	3	2	3	2	1	3	-	-	-	-	-	-	1	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

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

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

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

UNIT – III:

Power System Transients

Types of System Transients – Travelling or Propagation of Surges – Attenuation–Distortion– Reflection and Refraction Coefficients.

Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT–IV:

Various Factors governing the Performance of Transmission line

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current.

Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss – Radio Interference.

UNIT–V:

Sag and Tension Calculations and Overhead Line Insulators

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

Course Outcomes:

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

- Calculate transmission line parameters for different types of transmission lines.
- Determine the performance of short, medium and long transmission lines with different configurations.
- Know the propagation of surges/travelling waves on transmission lines for different terminations.
- Analyse various factors affecting the performance and effect of corona on the transmission line.
- Determine sag, tension and string efficiency of transmission lines and performance of line insulators.

Text Books:

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

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies, 4th edition
2. Power System Analysis and Design by B.R.Gupta, Wheeler Publishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar A.Chakrabarthy, DhanpatRai Co Pvt. Ltd.2016
4. Electrical Power Systems by P.S.R. Murthy, B.S. Publications, 2017.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year – I Semester

L	T	P	C
3	0	0	3

POWER ELECTRONICS

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	--	--	--	--	--	--	--	2	2	--	--
CO2	3	3	3	2	--	--	--	--	--	--	--	3	2	--	--
CO3	3	3	2	1	--	--	--	--	--	--	--	2	3	--	--
CO4	3	3	2	2	--	--	--	--	--	--	--	2	3	--	--
CO5	3	3	2	2	--	--	--	--	--	--	--	3	3	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT–I:
Power Semi-Conductor Devices

Thyristors–Silicon controlled rectifiers (SCR's) – Basic theory of operation of SCR–Static characteristics– Turn on and turn off methods–Dynamic characteristics of SCR– Snubber circuit design– Characteristics of power MOSFET and power IGBT–Diode bridge rectifier with R, RL–loads and capacitive filter–Output voltage and input current waveforms - Numerical problems.

UNIT–II:
Single Phase AC-DC Converters

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

UNIT–III:

Three Phase AC-DC Converters & AC – AC Converters

Three Phase half wave Rectifier with R and RL load -Three Phase fully controlled rectifier with R and RL load - Three Phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis - Three Phase Dual Converters - Numerical Problems.

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

UNIT–IV:

DC–DC Converters

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

UNIT – V:

DC–AC Converters

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

Course Outcomes:

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

- Explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR's.
- Design firing circuits for SCR.
- Explain the operation of single phase full–wave converters and analyze harmonics in the input current.
- Explain the operation of three phase full–wave converters.
- Analyze the operation of different types of DC-DC converters.
- Explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.
- Analyze the operation of AC-AC regulators.

Text Books:

1. Power Electronics: Converters, Applications and Design by Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.
2. Power Electronics: Circuits, Devices and Applications – by M. H. Rashid, Prentice Hall of India, 2nd edition, 1998
3. Power Electronics: Essentials & Applications by L.Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

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

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III Year – I Semester

L	T	P	C
3	0	0	3

LINEAR IC APPLICATIONS

Preamble:

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	--	--	3	--	--	--	--	--	--	--	2	--	--
CO2	--	--	1	--	--	--	--	--	--	--	--	--	--	2	1
CO3	--	--	--	2	--	--	--	--	--	--	--	--	1	--	2
CO4	--	--	--	2	--	--	--	--	--	--	--	--	--	2	--
CO5	1	--	--	--	2	--	--	--	--	--	--	--	1	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT I

Characteristics of OP-Amps:

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

UNIT II

Linear and Non-Linear Applications of Op-Amps:

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

UNIT III

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 Outcomes:

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

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

Text Books:

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

References Books:

1. Operational Amplifiers & Linear Integrated Circuits –Sanjay Sharma ;SK Kataria &Sons; 2nd Edition, 2010
2. Design with Operational Amplifiers & Analog Integrated Circuits – Sergio Franco, McGraw Hill, 1988.
3. OP AMPS and Linear Integrated Circuits concepts and Applications, James M Fiore, Cenage Learning India Ltd, 2018.
4. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll,
   PHI, 6th Edition.
5. Operational Amplifiers & Linear ICs – David A Bell, Oxford Uni. Press, 3rd Edition

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L	T	P	C
3	0	0	3

DIGITAL SIGNAL PROCESSING

Preamble:

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	--	--	--	--	--	--	--	--	1	2	--	--
CO2	3	2	2	1	--	--	--	--	--	--	--	3	2	--	--
CO3	3	3	3	3	--	--	--	--	--	--	--	2	3	--	--
CO4	3	3	3	2	--	--	--	--	--	--	--	2	3	--	--
CO5	2	1	1	1	--	--	--	--	--	--	--	2	1	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I:

Introduction

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

UNIT-II:

Discrete Fourier Series & Fourier Transforms

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

UNIT-III:

Design of IIR Digital Filters& Realizations

Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples.

Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms.

UNIT-IV:

Design of FIR Digital Filters & Realizations

Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters. Basic structures of FIR systems, Lattice structures, Lattice-ladder structures

UNIT-V:

Multirate Digital Signal Processing

Introduction, Decimation, Interpolation Sampling rate conversion, Implementation of sampling rate converters, Applications – Sub-band Coding of Speech Signals, Implementation of Digital Filter Banks, Trans-multiplexers.

Course Outcomes:

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

- Understand the basic concepts of Digital Signal Processing and related transforms.
- Evaluate the DFT using direct computation and Fast Fourier algorithms.
- Design and realize of IIR digital filters.
- Develop and realize of FIR digital filters.
- Appreciate the concepts of multirate signal processing.

Text Books:

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

Reference Books:

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

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III Year – I Semester

L	T	P	C
3	0	0	3

PYTHON PROGRAMMING
(Program Elective –I)

Preamble:
This course is developed to impart the programming skills to the students and prepare them to suitable for industry ready.

Course Objectives:
The Objectives of Python Programming are

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with universal computer programming concepts like data types, containers
- To be familiarized with general computer programming concepts like conditional execution, loops & functions
- To be familiarized with general coding techniques and object-oriented programming
- Identify errors and exceptions, develop GUI based programs

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	2	2	--	--	--	--	--	--	--	2	1	1
CO2	--	--	2	3	3	--	--	--	--	--	--	--	2	1	1
CO3	--	--	1	3	3	--	--	--	--	--	--	--	2	1	1
CO4	1	2	2	2	2	--	--	--	--	--	--	--	2	1	1
CO5	--	1	2	2	3	--	--	--	--	--	--	--	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I
Introduction:
Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output.
Data Types, and Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules.
Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested Loops.

UNIT- II
Control Statement:
Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration The While Loop
Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files.

UNIT -III

List and Dictionaries:

Lists, Defining Simple Functions, Dictionaries

Design with Function**:** Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function.

Modules: Modules, Standard Modules, Packages.

UNIT- IV

File Operations:

Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Object Oriented Programming**:** Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using OOPs support

Design with Classes: Objects and Classes, Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritance and Polymorphism

UNIT -V

Errors and Exceptions:

Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions.

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Programming**:** Introduction to Programming Concepts with Scratch.

Course Outcomes:

- Understand Python Programming language syntax, sematics and run time environment.
- Create computer programming concepts like data types.
- Create computer programming concepts like conditional execution, loops and functions.
- Analyzing general codeing techniques and object oriented programming.
- Investigate the errors & exceptions and develop GUI based programs.

Text Books

1) Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2/e, 2011.

Reference Books:

1) Introduction to Python Programming, Gowrishankar S., VeenaA, CRC Press, 2nd Edition, 2019.
2) Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 1st Edition, 2012.

e-Resources:

1) https://www.tutorialspoint.com/python3/python_tutorial.pdf

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DATA STRUCTURES

(Program Elective –I)

Preamble:

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

Course Objectives:

- To understand operations on linear data structures and their applications.
- To understand various operations on linked lists.
- To understand basic concepts of Trees, Traversal methods and operations.
- To understand concepts of implementing graphs and its relevant algorithms.
- To understand sorting and searching algorithms.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	-	-	1	-	-	-	-	-	-	1	1	2	1
CO2	2	2	-	-	1	-	-	-	-	-	-	1	1	2	1
CO3	2	2	2	2	2	-	-	-	-	-	-	1	1	2	1
CO4	2	2	3	2	3	-	-	-	-	-	-	2	1	2	1
CO5	2	2	3	2	3	-	-	-	-	-	-	2	1	2	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit-1:

Linear Data Structures: Arrays, Stacks and Queues

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

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

Unit-II:

Linked Lists

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

Unit-III:

Trees

Terminology-Representation of Trees-Binary Trees-Properties of Binary Trees-Binary Tree Representations-Binary Tree Traversal-Preorder-Inorder and Postorder Traversal.

Threads-Thread Binary Trees-Balanced Binary Trees-Heaps-Max Heap-Insertion into and Deletion from a Max Heap-Binary Search Trees-Searching-Insertion and Deletion from a Binary Search Tree-Height of Binary Search Tree, m-way Search Trees, B-Trees.

Unit-IV:

Graphs

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

Unit-V:

Searching and Sorting

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

Course Outcomes:

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

- Data structures concepts with arrays, stacks, queues.
- Linked lists for stacks, queues and for other applications.
- Traversal methods in the Trees and different sorting methods.
- Various algorithms available for the graphs.
- Sorting and searching in the data ret retrival applications.

Text Books:

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

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OOPS THROUGH JAVA

(Program Elective –I)

Preamble:

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	--	1	2	--	--	--	--	--	--	--	1	--	--
CO2	2	--	--	1	2	--	--	--	--	--	--	--	1	--	--
CO3	2	--	--	1	2	--	--	--	--	--	--	--	1	--	--
CO4	2	--	--	1	2	--	--	--	--	--	--	--	1	--	--
CO5	2	--	--	1	2	--	--	--	--	--	--	--	1	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I:

Introduction to JAVA:

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

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

UNIT-II:

Objects and Classes:

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

UNIT-III:

Inheritance:

Inheritance, types of inheritance, super keyword, final keyword, overriding and abstract class. Interfaces, creating the packages, using packages, importance of CLASSPATH and java.lang package.

Exception handling, importance of try, catch, throw, throws and finally block, user-defined exceptions, Assertions.

UNIT-IV:

Multithreading:

Introduction, thread life cycle, creation of threads, thread priorities, thread synchronization, communication between threads. Reading data from files and writing data to files, random access file.

UNIT-V:

Applets and AWT Classes:

Applet class, Applet structure, Applet life cycle, sample Applet programs. Event handling: event delegation model, sources of event, Event Listeners, adapter classes, inner classes.

AWT: introduction, components and containers, Button, Label, Checkbox, Radio Buttons, List Boxes, Choice Boxes, Container class, Layouts, Menu and Scrollbar.

Course Outcomes:

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

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

Text Books:

1. The complete Reference Java, 8th edition, Herbert Schildt, TMH.
2. Programming in JAVA, Sachin Malhotra, Saurabh Choudary, Oxford.2013
3. Introduction to java programming, 7th edition by Y Daniel Liang, Pearson.

Reference Books:

1. “Object-Oriented Programming and Java” By Danny Poo, Derek Kiong, Swarnalatha Ashok, Springer London,2008.
2. “Object Oriented Programming with Java” by M. T. Somashekara, D. S. Guru, K. S. Manjunatha, Prentice Hall India Pvt., Limited,2017.

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3	0	0	3

OPERATING SYSTEMS

(Program Elective –I)

Preamble:

This is an elective course introduced to understand the principles of operating systems used in SCADA, Power Systems Automation. This course cover the operating system process scheduling, inter process communication, memory management, synchronization, file system and types of operating systems

Course Objectives:

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.
- Study I/O management and File systems.
- Learn the basics of Linux system and perform administrative tasks on Linux Servers.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	--	--	--	--	--	--	--	--	--	1	1	1	1
CO2	--	--	--	--	--	--	--	--	--	--	--	1	1	1	1
CO3	2	1	3	1	--	--	--	--	--	--	--	1	1	1	1
CO4	2	--	2	--	--	--	--	--	--	--	--	1	1	1	1
CO5	--	--	--	--	3	--	--	--	--	--	--	1	1	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT I:

Introduction to Operating System and Concept Process Management

Types of operating systems, operating systems concepts, operating systems services, Introduction to System call, System call types. Process concept, The process, Process State Diagram , Process control block, Process Scheduling- Scheduling Queues, Schedulers, Operations on Processes, Interprocess Communication, Threading Issues, Scheduling-Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

UNIT-II:

Memory Management

Swapping, Contiguous Memory Allocation, Paging, structure of the Page Table, Segmentation

Virtual Memory Management

Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing

UNIT-III:

Concurrency

ProcessSynchronization, The Critical- Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples.

Principles of deadlock

System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery form Deadlock

UNIT-IV:

File system Interface

The concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.

File System implementation- File system structure, allocation methods, free-space management

Mass-storage structure overview of Mass-storage structure, Disk scheduling, Device drivers,

UNIT V:

Linux System

Components of LINUX, Interprocess Communication, Synchronisation, Interrupt, Exception and System Call.

Android Software Platform

Android Architecture, Operating System Services, Android Runtime Application Development, Application Structure, Application Process management

Course Outcomes:

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

- Design various Scheduling algorithms.
- Apply the principles of concurrency.
- Design deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes and design & Implement a prototype file systems.
- Perform administrative tasks on Linux Servers and basic Introduction to Android Operating System Internals.

Text Books:

1. Operating System Concepts,Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
3. Operating Systems-S Halder, Alex A Aravind Pearson Education Second Edition 2016 .

References Books:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach,Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata Mc Graw-Hill Education, 2007

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

III Year – I Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL MACHINES-II LABORATORY

Course objectives:

- To analyze the performance of three-phase Induction motor by conducting different tests
- To compute the regulation of three–phase alternator by various methods, find X_d / X_q ratio of alternator and asses the performance of three–phase synchronous motor
- To analyze the performance and power factor improvement methods of single-phase induction motor

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	1	-	-	2	1	1	2	3	3	2
CO2	3	2	2	2	-	1	-	-	2	1	1	2	3	3	2
CO3	3	2	2	2	-	1	-	-	2	1	1	2	3	2	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

Any 10 of the following experiments are to be conducted:

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

Course outcomes:

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

- Analyze the performance of three-phase Induction motor by conducting different tests
- Determine the regulation of three–phase alternator by various methods, find X_d / X_q ratio of alternator and asses the performance of three–phase synchronous motor.
- Analyze the performance and power factor improvement methods of single-phase induction motor

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III Year – I Semester

L	T	P	C
0	0	3	1.5

CONTROL SYSTEMS LABORATORY

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	--	--	--	--	--	--	1	2	2	1	2
CO2	2	2	2	2	--	--	--	--	--	--	1	2	2	2	2
CO3	2	2	2	1	--	--	--	--	--	--	--	2	2	1	2
CO4	3	2	2	1	1	--	--	--	--	--	--	2	2	2	1
CO5	3	2	2	1	1	--	--	--	--	--	--	2	2	1	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any 10 of the following experiments are to be conducted:

1. Analysis of second order system in time domain.
2. Determination of performance characteristics of Synchro pair as error detector.
3. Determination of performance of a second order systems with P, PD, PI, PID Controllers.
4. Design of Lag and lead compensating network using frequency domain technique.
5. Transfer function of DC motor
6. Determination of stability of the transfer functions using Bode Plot, Root locus, Nyquist Plots by simulation tools.
7. Kalman's test of Controllability and Observability.
8. Temperature controller using PID
9. Performance analysis of magnetic amplifiers
10. Performance analysis of AC servo motor
11. Performance analysis of DC servo motor
12. Block Diagram Representation of Field Controlled DC servo Motor.

Course Outcomes:

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

- Analyze the performance and working Magnetic amplifier, D.C and A.C. servo motors, synchros and second order systems in time domine.
- Design P,PI,PD and PID controllers and lag, lead and lag–lead compensators
- Illustrate the temperature of oven using PID controller
- Determine the transfer function of D.C Motor
- Analyze the stability of the transfer function using Bode plot, Nyquist Plot, Root Locus and Kalman's test of controllability and observability.
- Judge the stability in time and frequency domain.

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III Year – I Semester

L	T	P	C
0	0	3	1.5

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LABORATORY

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	--	--	--	--	--	2	2	--	--	2	2	1
CO2	2	3	1	--	--	--	--	--	2	2	--	--	2	2	1
CO3	2	3	1	--	--	--	--	--	2	2	--	--	2	2	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any 10 of the following experiments are to be conducted

1. Calibration of dynamometer wattmeter using phantom loading
2. Calibration of DC ammeter and voltmeter using Crompton D.C. Potentiometer.
3. Measurement of resistance using Kelvin's double Bridge and Determination of its tolerance.
4. Measurement of Capacitance using Schering Bridge.
5. Measurement of Inductance using Anderson Bridge.
6. Calibration of LPF Wattmeter by direct loading.
7. Measurement of 3 phase reactive power using single wattmeter method for a balanced load.
8. Testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null deflection method.
9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
10. AC Potentiometer – Polar form/Cartesian form – Calibration of AC Voltmeter, Parameters of Choke.
11. Determination of the characteristics of a Thermocouple.
12. Determination of the characteristics of a LVDT.
13. Determination of the characteristics for a capacitive transducer.
14. Determination of the characteristics of a piezoelectric transducer.
15. Measurement of strain for a bridge strain gauge.
16. Measurement of phase difference, frequency of two signals using Lissajous patterns.

Course Outcomes:

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

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

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III Year – I Semester

L	T	P	C
0	0	1	0.5

SOCIALLY RELEVANT PROJECTS-II

Energy Conservation Methods.
Energy Audit.
Automation
IoT applications
Renewable Energy Applications
Electrical safety
Electrical design aspects
Improvement of electrical skills.
Heating,ventilation and air conditioning.
Plug-in and Hybrid Electric vehicles.
Switchgear and its importance.
Protection of electrical utilities
Commercial power savers.

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III Year – I Semester

L	T	P	C
3	0	0	0

EMPLOYABILITY SKILLS-II

Course Outcomes: After completion of this course

CO	Course Outcomes	Knowledge Level (K)#
CO1	Solve various Basic Mathematics problems by following different methods	**K3**
CO2	Follow strategies in minimizing time consumption in problem solving Apply shortcut methods to solve problems	**K2**
CO3	Confidently solve any mathematical problems and utilize these mathematical skills both in their professional as well as personal life.	**K3**
CO4	Analyze, summarize and present information in quantitative forms including table, graphs and formulas	**K4**

SYLLABUS:

UNIT I:

Numerical ability I: Number system, HCF & LCM, Average, Simplification, Problems on numbers

Numerical ability II: Ratio & Proportion, Partnership, Percentages, Profit & Loss

UNIT II:

Arithmetical ability I: Problems on ages, Time & Work, Pipes & Cistern, Chain Rule.

Arithmetical ability II: Time & Distance, Problems on boats &Steams, Problems on Trains

UNIT III:

Arithmetical ability III: Allegation, Simple interest and compound interest, Races & Games of skills, Calendar and Clock, **Logical ability:** Permutations and Combination and Probability.

UNIT IV: Mensuration: Geometry, Areas, Volumes, **Data interpretation:** Tabulation, Bar graphs, Pie charts, line graphs

TEXT BOOKS AND REFERENCE BOOKS:

1. R. S. Aggarwal "Quantitative Aptitude", Revised ed., S Chand publication, 2017 ISBN:8121924987

E- resources:

1. https://blog.feedspot.com/aptitude_youtube_channels/
2. https://www.tutorialspoint.com/quantitative_aptitude/
   https://www.careerbless.com/aptitude/qa/home.php

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III Year – II Semester

L	T	P	C
3	0	0	3

ELECTRIC DRIVES

Preamble:

This course is an extension of power electronics applications to electric drives. This course covers in detail the basic and advanced speed control techniques using power electronic converters. This course also covers four quadrant operation of electric drives and slip power recovery schemes in induction motors.

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	1	-	-	-	-	1	2	2	2	2
CO2	3	3	3	3	-	1	-	-	-	-	1	3	3	3	2
CO3	3	3	2	2	-	1	-	-	-	-	1	2	3	3	2
CO4	3	3	3	3	-	1	-	-	-	-	1	3	3	3	2
CO5	3	3	3	3	-	1	-	-	-	-	1	3	3	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

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

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

UNIT–III:

DC–DC Converters Fed DC Motor Drives

Single quadrant – Two quadrant and four quadrant DC-DC converter fed separately excited and self-excited DC motors – Continuous current operation.

Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics – Four quadrant operation – Closed loop operation (qualitative treatment only).

UNIT–IV:

Stator side control of 3-phase Induction motor Drive

Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by PWM voltage source inverter – Closed loop V/f control of induction motor drives (qualitative treatment only) - Current source inverter.

UNIT–V:

Rotor side control of 3-phase Induction motor Drive & Synchronous Motor Drives

Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications.
Separate control of synchronous motor – self-control of synchronous motor employing load commutated thyristor inverter - closed loop control of synchronous motor drive (qualitative treatment only)– PMSM (Basic operation only).

Course Outcomes:

Student should be able to

- Understand the fundamentals of electric drive and different electric braking methods.
- Analyze the operation of three-phase converter-controlled DC motors and four quadrant operation of DC motors using dual converters.
- Explain the converter control of dc motors in various quadrants.
- Show the application of AC voltage controllers and voltage source inverters for speed control of induction motors.
- Understand the principles of static rotor resistance control and various slip power recovery schemes. Explain the speed control mechanism of synchronous motors

Text Books:

1. Fundamentals of Electric Drives – by G K Dubey, Narosa Publications,2nd edition,2002.
2. Power Semiconductor Drives, by S.B.Dewan, G.R.Slemon, A.Straughen, Wiley-India, 1984.

Reference Books:

1. Electric Motors and Drives Fundamentals, Types and Apllications, by Austin Hughes and Bill Drury, Newnes.4th edition, 2013.
2. Thyristor Control of Electric drives – Vedam Subramanyam Tata McGraw Hill Publications, 1987.
3. Power Electronic Circuits, Devices and applications by M.H.Rashid, PHI, 3rd edition, 2009.
4. Power Electronics handbook by Muhammad H.Rashid, Elsevier, 2nd edition, 2010.

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III Year – II Semester

L	T	P	C
3	0	0	3

POWER SYSTEM ANALYSIS

Preamble:

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO2	3	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO3	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO4	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO5	3	3	3	2	3	1	-	-	-	-	-	-	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT –I:

Circuit Topology & Per Unit Representation

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

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 – Numerical Problems on 3–bus system only.

UNIT – III:

Z-Bus Algorithm & Symmetrical Fault Analysis

Formation of Z_{bus}**:** Algorithm for the Modification of Z_{bus} Matrix (without mutual impedance) Numerical Problems.

Symmetrical Fault Analysis:

Reactance's of Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems - Numerical Problems.

UNIT –IV:

Symmetrical Components

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

Unsymmetrical Fault analysis

Various types of faults LG– LL– LLG and LLL on unloaded alternator-Numerical problems.

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- Numerical problems.

Course Outcomes:

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

- Draw impedance diagram for a power system network and calculate per unit quantities.
- Apply the load flow solution to a power system using different methods.
- Form Z_{bus} for a power system network and analyze the effect of symmetrical faults.
- Find the sequence components for power system Components and analyze its effects of unsymmetrical faults.
- Analyze the stability concepts of a power system.

Text Books:

1. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.2003
2. Modern Power system Analysis – by I.J.Nagrath & D .P.Kothari: Tata McGraw–Hill Publishing Company, 3rd edition, 2007.

Reference Books:

1. Power System Analysis – by A.R.Bergen, Prentice Hall, 2nd edition, 2009.
2. Power System Analysis by HadiSaadat – Tata McGraw–Hill 3rd edition, 2010.
3. Power System Analysis by B.R.Gupta, A H Wheeler Publishing Company Limited, 1998.
4. Power System Analysis and Design by J.Duncan Glover, M.S.Sarma, T.J.Overbye – Cengage Learning publications, 5th edition, 2011.

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III Year – II Semester

L	T	P	C
3	0	0	3

MICROPROCESSORS AND MICROCONTROLLERS

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

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	--	--	--	--	--	--	--	1	3	2	1
CO2	3	1	2	1	--	--	--	--	--	--	--	1	3	3	2
CO3	3	2	3	2	1	--	--	--	--	--	--	1	3	3	2
CO4	3	2	2	2	--	--	--	--	--	--	--	1	3	3	2
CO5	3	1	2	2	3	--	--	--	--	--	--	1	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

UNIT–II:
Minimum and Maximum Mode Operations
Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT–III:
Microprocessors I/O interfacing
8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086.
Architecture and interfacing of 8251 USART – Architecture and interfacing of 8254 Timer/counter – Architecture and interfacing of DMA controller (8257).

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

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

Course Outcomes:
After the completion of the course the student should be able to:
- Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors..
- Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors Understand the Microcontroller capability
- Analyse the Microcontroller and interfacing capability
- Describe the architecture and interfacing of 8051 controller
- Know the concepts of PIC micro controller and its programming.

Text Books:
1. Ray and Burchandi, "Advanced Microprocessors and Interfacing", Tata McGraw–Hill, 3rd edition, 2006.
2. Kenneth J Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Thomson Publishers, 2nd Edition.
3. PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18, - Muhammad Ali Mazidi, RolindD.Mckinay , Danny causey -Pearson Publisher 21st Impression.

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

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L	T	P	C
3	0	0	3

RENEWABLE ENERGY SOURCES
(Open Elective – I)

Preamble:

This course gives a flavor of present trend on renewable sources and systems to the students. It empowers the students to understand the need of the hour with respect to renewable energy sources. It also introduces solar energy its radiation, collectors and energy storages along with its applications. This covers generation, design, efficiency and characteristics of various renewable energy sources including solar, wind, hydro, biomass, fuel cells and geothermal systems.

Course Objectives:

- To study the solar radiation on earth's surface, solar collectors and energy storages.
- To study the concept of wind energy conversion systems, Betz coefficient, tip speed ratio.
- To know the basic principle and working of biomass and geothermal systems.
- To understand the basic principle and working of ocean, wave and tidal Energy.
- To study the basic principle and working of ocean, wave and tidal Energy.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	--	1	--	--	--	--	--	1	1	1
CO2	2	2	3	2	1	--	--	--	--	--	--	--	1	1	1
CO3	2	2	3	2	1	--	--	--	--	--	--	--	1	1	1
CO4	1	2	2	--	--	--	--	--	--	--	--	--	1	1	1
CO5	1	2	2	--	--	--	--	--	--	--	--	--	1	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT– I:

Solar Energy: Introduction, Renewable Sources, prospects, Solar radiation at the Earth Surface, Solar Energy Collectors-Flat plate Collectors, concentrating collectors, advantages and disadvantages, Solar Energy storage systems – Solar Pond. Applications of Solar Energy-Solar water heating, Solar Green house

UNIT– II:

Wind Energy: Introduction, basic Principles of Wind Energy Conversion, the nature of Wind, the power in the wind, Wind Energy Conversion, Site selection considerations, basic components of a WECS (Wind Energy Conversion Systems), Classification of WEC Systems, Advantages and Disadvantages of WECS, Applications of Wind Energy

UNIT–III:

Biomass and Geothermal Energy:

Biomass: Introduction, Biomass conversion technologies, Photosynthesis, factors affecting Bio digestion, classification of biogas plants, advantages and their disadvantages, Types of biogas plants, selection of site for a biogas plant

Geothermal Energy: Introduction, Geothermal Sources, Applications of geothermal Energy, Advantages and Disadvantages, operational and Environmental problems.

UNIT– IV:

Energy From oceans, Waves & Tides:

Oceans: Introduction, Ocean Thermal Electric Conversion (OTEC), methods, Advantages and Disadvantages, prospects of OTEC in India.

Waves: Introduction, Energy and Power from the waves, Wave Energy conversion devices, Advantages and Disadvantages

Tides: Basic principle of Tide Energy, Components of Tidal Energy, Advantages and limitations of Tidal power Generation.

UNIT– V:

Chemical Energy Sources:

Fuel Cells: Introduction, Fuel Cell Equivalent Circuit, operation of Fuel cell, types of Fuel Cells, Advantages and Disadvantages of Fuel Cells, Applications of Fuel Cells.

Hydrogen Energy: Introduction, Methods of Hydrogen production, Storage and Applications

Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation, Types, advantages and disadvantages.

Course outcomes:

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

- Analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface and solar Energy Storage.
- Design the of Wind Energy Systems.
- Design of biomass digesters, Geothermal plants and its working characteristics
- Know the Energy production from OTEC, Tidal and Waves.
- Evaluate the concept and working of Fuel cells & MHD power generation.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, khanna Publications, 2011.
2. John Twidell & Tony Weir, Renewable Energy Sources, Taylor & francis, 2013.

Reference Books:

1. S.P.Sukhatme & J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, technologies and Impacts, Oxford, 2nd edition, 2013.

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

III Year – II SEMESTER

L	T	P	C
3	0	0	3

ENERGY AUDITING, CONSERVATION AND MANAGEMENT
(Open Elective – I)

Preamble:
This course Energy Auditing, Conservation and Management gives the overall significance of Energy Savings. The role of Auditor and Energy Manager in choosing and calculating the efficient energy by reducing cost and pollution created by sources of energy. It is important to the student to understand the basic concepts of Energy Audit and the various roles of Energy Manager in the industry. Also the concept of Energy Techniques like energy efficient motors, Lighting, power factor improvement and various energy efficient instruments were discord here. The calculation of basic payback period, cost analysis and economic aspects were also discussed.

Course Objectives:

- To study the basic principles of Energy Auditing along with its various terminologies & schemes.
- To study the role of energy manager in the industries and significance Energy Management program.
- To know the significance of Energy efficient motor and lighting schemes with Energy Savings applications.
- To understand the effects of low power factor and its impact on various systems and to study the principles of energy instruments
- To study the forecasting, cost analysis and economic concepts and their computation.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	--	--	--	--	--	--	--	--	--	2	2	1
CO2	2	--	2	--	--	--	--	--	--	--	--	--	2	2	1
CO3	2	--	2	--	--	--	--	--	--	--	--	--	2	2	1
CO4	2	1	2	--	--	--	--	--	--	--	--	--	2	2	1
CO5	2	2	2	--	--	--	--	--	--	--	--	--	2	2	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT– I:

Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT– II:

Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language, Questionnaire – check list for top management

UNIT– III:

Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit

UNIT– IV:

Power Factor Improvement and energy instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers.

UNIT– V:

Economic Aspects and their computation:

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Course Outcomes:

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

- Understand the principles of energy audit along with various Energy related terminologies.
- Understand the role of Energy Manager and Energy Management program.
- Recommend energy efficient motors and design a good lighting system.
- Understand the process to improve the power factor and identify the energy instruments for various real time applications.
- Evaluate the computational techniques with regard to economic aspects.

Text Books:

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John wiley and sons, 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO

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III Year – II Semester

L	T	P	C
3	**0**	**0**	3

OPTIMIZATION TECHNIQUES
(Open Elective – I)

Preamble:

Optimization techniques have gained importance to solve many engineering design problems by developing linear and nonlinear mathematical models. The aim of this course is to educate the student to develop a mathematical model by defining an objective function and constraints in terms of design variables and then apply a particular mathematical programming technique. This course covers classical optimization techniques, linear programming, nonlinear programming and dynamic programming techniques.

Course Objectives:

- To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To state transportation and assignment problem as a linear programming problem to determine optimality conditions by using Simplex method.
- To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
- To explain Dynamic programming technique as a powerful tool for making a sequence of interrelated decisions.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	--	2	--	--	--	--	--	--	--	2	3	2
CO2	2	2	2	--	2	--	--	--	--	--	--	--	2	3	2
CO3	3	2	3	1	2	--	--	--	--	--	--	--	2	3	2
CO4	2	2	2	2	1	--	--	--	--	--	--	--	2	3	2
CO5	2	2	2	--	2	--	--	--	--	--	--	--	2	3	2
CO6	2	2	2	--	2	--	--	--	--	--	--	--	2	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I:

Introduction to Optimization Techniques:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality

constraints. Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II:
Linear Programming
Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

UNIT – III:
Nonlinear Programming:
Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method.
Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods. Introduction to convex Programming Problem.

UNIT – IV:
Transportation Problem
Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems – Special cases in transportation problem.

UNIT – V:
Dynamic Programming:
Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

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

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Solve transportation and assignment problem by using Linear programming Simplex method.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
- Formulate and apply Dynamic programming technique to inventory control, production planning, engineering design problems etc. to reach a final optimal solution from the current optimal solution.

Text Books:

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. "Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer (India) 2013.

Reference Books:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and
   C. Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma, Kedarnath, Ramnath & Co,2012.
3. "Operations Research: An Introduction" – by H.A.Taha,PHI pvt. Ltd., 6th edition
4. Linear Programming–by G.Hadley.

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III Year – II SEMESTER

L	T	P	C
3	0	0	3

ENERGY AUDITING, CONSERVATION AND MANAGEMENT
(Program Elective – II)

Preamble:
This course Energy Auditing, Conservation and Management gives the overall significance of Energy Savings. The role of Auditor and Energy Manager in choosing and calculating the efficient energy by reducing cost and pollution created by sources of energy. It is important to the student to understand the basic concepts of Energy Audit and the various roles of Energy Manager in the industry. Also the concept of Energy Techniques like energy efficient motors, Lighting, power factor improvement and various energy efficient instruments were discord here. The calculation of basic payback period, cost analysis and economic aspects were also discussed.

Course Objectives:
- To study the basic principles of Energy Auditing along with its various terminologies & schemes.
- To study the role of energy manager in the industries and significance Energy Management program.
- To know the significance of Energy efficient motor and lighting schemes with Energy Savings applications.
- To understand the effects of low power factor and its impact on various systems and to study the principles of energy instruments
- To study the forecasting, cost analysis and economic concepts and their computation.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	--	--	--	--	--	--	--	--	--	2	2	1
CO2	2	--	2	--	--	--	--	--	--	--	--	--	2	2	1
CO3	2	--	2	--	--	--	--	--	--	--	--	--	2	2	1
CO4	2	1	2	--	--	--	--	--	--	--	--	--	2	2	1
CO5	2	2	2	--	--	--	--	--	--	--	--	--	2	2	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT– I:
Basic Principles of Energy Audit
Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT– II:

Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language, Questionnaire – check list for top management

UNIT– III:

Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed, RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit

UNIT– IV:

Power Factor Improvement and energy instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers.

UNIT– V:

Economic Aspects and their computation:

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method- Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Course Outcomes:

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

- Understand the principles of energy audit along with various Energy related terminologies.
- Understand the role of Energy Manager and Energy Management program.
- Recommend energy efficient motors and design a good lighting system.
- Understand the process to improve the power factor and identify the energy instruments for various real time applications.
- Evaluate the computational techniques with regard to economic aspects.

Text Books:

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John wiley and sons, 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO

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III Year – II Semester

L	T	P	C
3	**0**	**0**	3

ELECTRICAL DISTRIBUTION SYSTEMS
(Program Elective –II)

Preamble:
This subject deals with the general concept of distribution system, substations and feeders as well as discusses distribution system analysis, protection and coordination, voltage control and power factor improvement.

Course Objectives
- To study different factors of Distribution system.
- To study and design the substations and distribution systems.
- To study the concepts of voltage drop and power loss.
- To study the distribution system protection and its coordination.
- To study the effect of compensation for power factor improvement.
- To study the effect of voltage control on distribution system.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	1	2	-	-	-	-	-	-	2	3	1
CO2	3	2	3	1	1	3	-	-	-	-	-	-	2	3	1
CO3	3	2	3	2	1	3	-	-	-	-	-	3	2	3	1
CO4	3	2	3	2	1	2	-	-	-	-	-	-	2	3	1
CO5	3	2	3	2	1	3	-	-	-	-	-	3	2	3	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT – I:
General Concepts
Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor loss factor – Relationship between the load factor and loss factor - Numerical Problems – Load Modeling and Characteristics – Classification and characteristics of loads (Residential, commercial, Agricultural and Industrial).

UNIT – II:
Substations
Selection for location of substations **-** Rating of distribution substation – Service area with'n'primary feeders – Benefits and methods of optimal location of substations..
Distribution Feeders
Design Considerations of distribution feeders**:** Radial and loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III:
System Analysis
Voltage drop and power–loss calculations**:** Derivation for voltage drop and power loss in lines – Uniformly distributed loads and non-uniformly distributed loads - Three phase balanced primary lines – and Non three phase balanced primary lines - Numerical problems

UNIT – IV:

Protection

Objectives of distribution system protection –Time current characteristics – Protective devices**:** Principle of operation of fuses – Circuit reclosures – Line sectionalizes and circuit breakers, Modulated case circuit breakers, Earth leakage circuit breakers – Protection schemes of parallel & Ringmain feeders.

Coordination of protective devices

General coordination procedure –Various types of co-ordinated operation of protective devices - Residual Current Circuit Breaker

UNIT – V:

Compensation for Power Factor Improvement

Capacitive compensation for power factor control – Different types of power capacitors – shunt and series capacitors – Effect of shunt capacitors (Fixed and switched) – Power factor correction – Capacitor allocation – Economic justification – Procedure to determine the best capacitor location – Numerical problems.

Voltage Control

Equipment for voltage control – Effect of series capacitors – Effect of AVB/AVR – Line drop compensation – Numerical problems.

Course Outcomes:

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

- Discriminate various factors for distribution systems, load modeling and characteristics of loads.
- Know the concepts of design considerations for substations and distribution feeders.
- Determine the voltage drop and power loss calculations for different types of distribution loads.
- Analyze the protection and its coordination for distribution systems.
- Analyze the effect of compensation for p.f improvement and understand the effect of voltage control.

Text Book:

1. "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw–hill, 2nd edition, 2008.

Reference Books:

1. Electrical Distribution Systems by Dale R.Patrick and Stephen W.Fardo, CRC press, 2nd edition.
2. Electric Power Distribution – by A.S. Pabla, Tata McGraw–hill Publishing Company, 4th edition, 1997.
3. Electrical Power Distribution Systems by V.Kamaraju, Right Publishers.

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III Year – II Semester

L	T	P	C
3	0	0	3

RENEWABLE ENERGY TECHNOLOGIES
(Program Elective –II)

Preamble:

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

Course Educational Objectives:

- To study the solar radiation data, extra-terrestrial radiation, radiation on earth's surface, collection of solar energy and its storage.
- To study solar photo voltaic system characteristics, design and extraction of maximum power.
- To study basic working principles of Hydro and Tidal Power generators.
- To study wind energy conversion systems, Betz coefficient, tip speed ratio and extraction of maximum power.
- To study basic principle and working of biomass and geothermal systems.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	--	1	--	--	--	--	--	3	2	2
CO2	3	3	2	1	1	--	--	--	--	--	--	--	3	3	3
CO3	--	2	3	1	1	--	--	--	--	--	--	--	1	1	2
CO4	2	2	3	1	1	--	--	--	--	--	--	--	3	2	2
CO5	--	2	3	1	1	--	--	--	--	--	--	--	1	1	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT–I:

Fundamentals of Energy Systems

Energy conservation principle – Energy scenario (world and India) – Environmental impact of solar power, Solar radiation**:** Outside earth's atmosphere – Earth surface – Instruments for measuring solar radiation and sun shine, solar radiation data.

Solar energy collection and energy storage

Flat plate and concentrating collectors, classification of concentrating collectors, orientation, advanced collectors. solar ponds. Solar applications-solar heating/cooling techniques, solar distillation and drying.

UNIT–II:

Solar Photovoltaic Systems

Balance of systems – I-V characteristics – System design**:** storage sizing – PV system sizing – Maximum power point tracking techniques**:** Perturb and observe (P&O) technique – Hill climbing technique.

UNIT–III:

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–IV:

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–V:

Biomass and geothermal systems

BIO-MASS**:** Principles of Bio-Conversion, acrobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, ICE Engine operation and economic aspects

Geothermal: Resources, types of wells, methods of harnessing the energy, potential in india

.

Course Outcomes:

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

- Analyze solar radiation data, extraterrestrial radiation, radiation on earth's surface and types of solar energy collectors and design solar thermal collections.
- Understand the I-V & P-V characteristics of PV systems and develop maximum power point techniques.
- Analyze the significance of Hydro & Tidal power systems.
- Analyze wind systems by understanding the patterns of wind, types of turbines, selection of generators and tracking of maximum power from it.
- Understand the importance of biomass and geothermal aspects.

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 - second edition, 2013.
3. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford, 2nd edition, 2013.

Reference Books:

1. Renewable Energy- Edited by Godfrey Boyle-oxford university press, 3rd edition, 2013.
2. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore, 2011.
3. Renewable Energy Technologies /Ramesh & Kumar /Narosa.
4. Renewable energy technologies – A practical guide for beginners – Chetan Singh Solanki, PHI, 2009.
5. Non-conventional energy source –B.H.khan- TMH-2nd edition, 2006.

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III Year – II Semester

L	T	P	C
3	0	0	3

SPECIAL ELECTRIC MACHINES
(Program Elective –II)

Preamble:
This is an advanced course on electrical machines. Students will be exposed to various special machines which are gaining importance in industry. This course covers topics related to principles, performance and applications of these special machines including switched reluctance motors, stepper motors, permanent magnet dc motors and linear motors.

Course Objectives:
- To explain theory of operation and control of switched reluctance motor.
- To explain the performance and control of stepper motors, and their applications.
- To describe the operation and characteristics of permanent magnet dc motor.
- To distinguish between brush dc motor and brush less dc motor**.**
- To explain the theory of travelling magnetic field and applications of linear motors.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	-	-	1	1	1	2	-	2	3	1
CO2	3	2	2	1	2	-	-	1	1	1	1	-	2	3	1
CO3	3	2	2	1	1	-	-	1	1	1	2	-	2	3	1
CO4	3	2	2	1	2	-	-	1	1	1	2	-	2	3	2
CO5	3	2	2	2	2	-	-	1	1	1	2	-	2	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit I:
Permanent magnet materials and PMDC motors
Introduction-classification of permanent magnet materials used in electrical machines-minor hysteresis loop and recoil line-Stator frames of conventional dc machines-Development of electronically commutated dc motor from conventional dc motor-Permanent-magnet materials and characteristics-B-H loop and demagnetization characteristics-high temperature effects-reversible losses-Irreversible losses-Mechanical properties, handling and magnetization-Application of permanent magnets in motors-power density-operating temperature range-severity of operation duty.

Unit II:
Stepper Motors
Principle of operation of Stepper Motor – Constructional details - Classification of stepper motors – Different configuration for switching the phase windings - Control circuits for stepper motors – Open loop and closed loop control of two phase hybrid stepping motor.

Unit III:
Switched Reluctance Motors
Construction and Principle of operation of Switched Reluctance Motor – Comparison of conventional and switched reluctance motors – Design of stator and rotor pole arcs.

Torque producing principle and torque expression – Different converter configurations for SRM – Drive and power circuits for SRM – Position sensing of rotor – Applications of SRM.

Unit IV:

Permanent Magnet Brushless DC Motor

Principle of operation of BLDC motor - Types of constructions - Surface mounted and interior type permanent magnet DC Motors - Torque and EMF equations for Square wave & Sine wave for PMBLDC Motor – Torque - Speed characteristics of Square wave & Sine wave for PMBLDC Motor - Merits & demerits of Square wave & Sine wave for PMBLDC Motor - Performance and efficiency – Applications.

Unit V:

Linear Induction Motors (LIM)

Construction– principle of operation–Double sided LIM from rotating type Induction Motor – Schematic of LIM drive for traction – Development of one sided LIM with back iron-equivalent circuit of LIM.

Course Outcomes:

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

- Learn merits of PMDC motor.
- Choose best control scheme for stepper motor.
- Construct the various converter circuits for Switched Reluctance Motors.
- Analyse the characteristics of Brushless dc Motor.
- Understand the operation of Linear Induction Motors.

Text Books:

1. Brushless Permanent magnet and reluctance motor drives, Clarenden press, T.J.E. Miller,
   1989, Oxford.
2. Special electrical Machines, K.Venkata Ratnam, University press, 2009, New Delhi.

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III Year – II Semester

L	T	P	C
3	0	0	3

IOT APPLICATIONS IN ELECTRICAL ENGINEERING
(Program Elective –III)

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	2	2	--	--	--	--	--	--	--	1	3	1
CO2	1	--	2	2	3	--	--	--	--	--	--	--	1	3	1
CO3	1	--	--	2	3	--	--	--	--	--	--	2	1	3	1
CO4	1	--	--	2	3	--	--	--	--	--	--	2	1	3	1
CO5	1	--	1	2	3	--	--	--	--	--	--	2	1	3	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

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 of IoT.

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:

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

- Know the various fundamentals, architectures and technologies of Internet of Things.
- Adapt various communication technologies used in the Internet of Things.
- Diagnose the various device connectivity methods using web and internet in the IoT environment.
- Analyze various data acquisition methods, data handling using cloud for IoT applications.
- Design the implementation of IoT from the case studies like Smart Home, Smart city, etc.

Text Books:

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

Reference Books:

1. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley, First Edition, 2013.
2. Getting Started with the Internet of Things, Cuno Pfister, O'Reilly, 2011.
3. Internet of Things: A Hands-on Approach, Arshdeep Bahga, and Vijay Madisetti, 2014.

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

DATA BASE MANAGEMENT SYSTEMS
(Program Elective –III)

Preamble:

This course is an elective course designed to impart knowledge in data bases to the students which may be useful the SCADA, power system automation, etc. This course covers database principles, Normal forms, Database models, SQL queries, Data storage etc.

Course Objectives:

- To Understand Fundamentals of DBMS.
- To know Different modes of DBMS.
- To Understand Basic query structures and normal forms.
- To Understand Control aspects of DBMS.
- To Understand File organization and indexing.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	--	1	--	--	--	--	--	--	--	1	1	1
CO2	3	2	2	--	1	--	--	--	--	--	--	--	1	1	1
CO3	2	2	2	--	1	--	--	--	--	--	--	--	1	1	1
CO4	2	2	2	--	1	--	--	--	--	--	--	--	1	1	1
CO5	2	2	2	--	1	--	--	--	--	--	--	--	1	1	1
CO6	2	2	2	--	1	--	--	--	--	--	--	--	1	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I:

An Overview of Database Management

Introduction- Definition of Database and Database System – Need of Database- Data Independence- Relation Systems and Others- Summary.

Database system architecture, Introduction - Three Levels of Architecture - External Level - Conceptual Level- Internal Level – Mapping - Database Administrator - Database Management Systems Client/Server Architecture

UNIT-II:

Entity-Relationship Models & Diagrams

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 and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

UNIT-IV:

Transaction Management and Concurrency Control

Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point.

Concurrency control for lost updates, uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods : lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering : Wait/Die and Wound/Wait Schemes, Database Recovery management : Transaction recovery.

UNIT-V:

Overview of Storages and Indexing

Data on External Storage- File Organization and Indexing –Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree-Based Indexing, Comparison of File Organization

Course Outcomes:

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

- Describe a relational database and object-oriented database.
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design.
- Examine issues in data storage and query processing and can formulate appropriate solutions.
- Understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage.
- Design and build database system for a given real world problem

Text Books:

1. Introduction to Database Systems, CJ Date, Pearson, 8th edition.

2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata McGraw Hill 3rd Edition

3. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom, Pearson Education, 2008.

References Books:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel, 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education, 2008.

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III Year – II Semester

L	T	P	C
3	0	0	3

DATA ANALYTICS WITH PYTHON
(Program Elective –III)

Preamble:
This course is developed to impart the python programming skills with data analytics to the students and prepare them to suitable for industry ready.

Course Objectives:
- To provide with the knowledge and expertise to become a proficient data scientist
- To demonstrate an understanding of statistics and machine learning concepts that are vital for data science
- To learn to statistically analyze a dataset
- To critically evaluate data visualizations based on their design and use for communicating stories from data

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	2	2	--	--	--	--	--	--	--	2	1	1
CO2	--	--	2	3	3	--	--	--	--	--	--	--	2	1	1
CO3	--	--	1	3	3	--	--	--	--	--	--	--	2	1	1
CO4	1	2	2	2	2	--	--	--	--	--	--	--	2	1	1
CO5	--	1	2	2	3	--	--	--	--	--	--	--	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I:
Introduction to statistical models:
Statistical Thinking in the Age of Big Data. Exploratory Data Analysis, The Data Science Process , Machine Learning Algorithms, Linear Regression, k-Nearest Neighbors (k-NN), k-means, Logistic Regression

UNIT – II:
Python Language Basics, IPython, and Jupyter Notebooks:
The Python Interpreter, IPython Basics, Python Language Basics, Built-in Data Structures, Functions, and Files, NumPy Basics: Arrays and Vectorized Computation, Introduction to pandas Data Structures, Essential Functionality, Summarizing and Computing Descriptive Statistics

UNIT – III:
Data Loading, Storage, and File Formats:
Reading and Writing Data in Text Format, Binary Data Formats, Interacting with Web APIs, Interacting with Databases

Data Cleaning and Preparation: Handling Missing Data, Data Transformation, String Manipulation

UNIT – IV:

Data Wrangling:

Join, Combine, and Reshape, Hierarchical Indexing, Combining and Merging Datasets, Reshaping and Pivoting - Plotting and Visualization: A Brief matplotlib API Primer, Plotting with pandas and seaborn - Other Python Visualization Tools.

UNIT – V:

Data Aggregation and Group Operations:

Group By Mechanics, Data Aggregation, Apply: General split-apply-combine, Pivot Tables and Cross-Tabulation - Time Series: Date and Time Data Types and Tools, Time Series Basics, Date Ranges, Frequencies, and Shifting, Time Zone Handling, Periods and Period Arithmetic, Resampling and Frequency Conversion, Moving Window Functions.

Course Outcomes:

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

- Describe what Data Analysis is and the skill sets needed to be a data scientist
- Explain in basic terms what Statistical Inference means.
- Identify probability distributions commonly used as foundations for statistical modelling, Fit a model to data
- Use Python to carry out basic statistical modeling and analysis
- Apply basic tools (plots, graphs, summary statistics) to carry out Data Analysis

Text Books:

1. Doing Data Science: Straight Talk From The Frontline, 1st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013.
2. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

Reference Books:

1. Anderson Sweeney Williams (2011). Statistics for Business and Economics. "Cengage Learning".
2. Douglas C. Montgomery, George C. Runger (2002). Applied Statistics & Probability for Engineering. "John Wiley & Sons, Inc"
3. Jiawei Han and Micheline Kamber (2006). "Data Mining: Concepts and Techniques."
4. "Algorithms for Data Science", 1st Edition, Steele, Brian, Chandler, John, Reddy, Swarna, springers Publications, 2016.

e-Resources:

1. https://nptel.ac.in/courses/106/107/106107220/

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III Year – II Semester

L	T	P	C
3	0	0	3

CLOUD COMPUTING
(Program Elective –III)

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	2	2	--	--	--	--	--	--	--	2	1	1
CO2	--	--	2	3	3	--	--	--	--	--	--	--	2	1	1
CO3	--	--	1	3	3	--	--	--	--	--	--	--	2	1	1
CO4	1	2	2	2	2	--	--	--	--	--	--	--	2	1	1
CO5	--	1	2	2	3	--	--	--	--	--	--	--	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT -I:

Systems modeling, Clustering and virtualization

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

UNIT- II:

Virtual Machines and Virtualization of Clusters and Data Centers

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

UNIT- III:

Cloud Platform Architecture

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

Cloud Programming and Software Environments

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

UNIT-IV:

Cloud Resource Management and Scheduling

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

UNIT- V:

Storage Systems

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

Course Outcomes:

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

- Understanding the key dimensions of the challenge of Cloud Computing
- Assessment of the economics , financial, and technological implications for selecting cloud computing for own organization
- Assessing the financial, technological, and organizational capacity of employer's for actively initiating and installing cloud-based applications.
- Developing of own organizations' needs for capacity building and training in cloud computing-related IT areas.
- Designing the various storage devices in the cloud.

Text Books:

1. Distributed and Cloud Computing, Kai Hwang, Geoffry C. Fox, Jack J. Dongarra MK Elsevier, 2011.
2. Cloud Computing, Theory and Practice, Dan C Marinescu, MK Elsevier, 2013.
3. Cloud Computing, A Hands on approach, Arshadeep Bahga, Vijay Madisetti, University Press, 2014.

Reference Books:

1. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, Tata McGraw Hill, 2009.
2. Mastering Cloud Computing, Foundations and Application Programming, Raj Kumar Buyya, Christen vecctiola, S Tammaraiselvi, MK Elsevier, 2013.

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III Year – II Semester

L	T	P	C
0	0	3	1.5

POWER ELECTRONICS LABORATORY

Course objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2	1	-	-	3	2	1	-	2	3	3
CO2	3	2	3	2	2	1	-	-	3	2	1	-	2	3	3
CO3	3	2	3	2	2	1	-	-	3	2	1	-	2	3	3
CO4	3	2	3	2	2	1	-	-	3	2	1	-	2	3	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

Any 10 of the Following Experiments are to be conducted

1. Characteristics of Thyristor, MOSFET & IGBT.
2. R, RC & UJT firing circuits for SCR.
3. Single -Phase semi converter with R & RL loads.
4. Single -Phase full converter with R & RL loads.
5. Three- Phase full converter with R &RL loads.
6. Single Phase dual converter in circulating current & non circulating current mode of operation.
7. Single -Phase AC Voltage Regulator with R & RL Loads.
8. Single Phase step down Cycloconverter with R & RL Loads.
9. Boost converter in Continuous Conduction Mode operation.
10. Buck converter in Continuous Conduction Mode operation.
11. Single -Phase square wave bridge inverter with R & RL Loads.
12. Single - Phase PWM inverter.
13. Three-phase bridge inverter with 12^0 and 180^0 conduction mode
14. SPWM control of Three-phase bridge inverter

Course outcomes:

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

- Study the characteristics of various power electronic devices.
- Analyze the performance of single–phase and three–phase full–wave bridge converters with both resistive and inductive loads.
- Understand the operation of single phase AC voltage regulator with resistive and inductive loads.
- Understand the working of Buck converter, Boost converter, single–phase square wave inverter, three phase inverter and PWM inverter.

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III Year – II Semester

L	T	P	C
0	0	3	1.5

LINEAR IC APPLICATIONS LAB

Course Outcomes:

CO1: Design and analyze the various linear application of op-amp.
CO2 : Design and analyze the various non-linear application of op-amp.
CO3 : Design and analyze filter circuits using op-amp
CO4 : Design and analyze oscillators and multivibrator circuits using op-amp
CO5: Design and analyze the various application of 555 timer.
CO6 : Analyze the performance of oscillators and multivibrators using trainer kits.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	2	--	2	--	--	--	--	--	--	--	--	1	--	2
CO2	--	2	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3	1	2	--	1	--	--	--	--	--	--	--	--	2	--	1
CO4	--	2	--	--	--	--	--	--	--	--	--	--	2	--	--
CO5	1	2	--	1	--	--	--	--	--	--	--	--	--	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

(Any 10 of the Following Experiments are to be conducted)

1. Study of ICs – IC 741, IC 555, IC 565, IC 566, IC 1496 – functioning, parameters and Specifications.
2. OP AMP Applications – Adder, Subtractor, Comparator Circuits.
3. Integrator and Differentiator Circuits using IC 741.
4. Active Filter Applications – LPF, HPF (first order)
5. Active Filter Applications – BPF, Band Reject (Wideband) and Notch Filters.
6. IC 741 Oscillator Circuits – Phase Shift and Wien Bridge Oscillators.
7. Function Generator using OP AMPs.
8. IC 555 Timer – Monostable Operation Circuit.
9. IC 555 Timer – Astable Operation Circuit.
10. Schmitt Trigger Circuits – using IC 741 and IC 555.
11. IC 565 – PLL Applications.
12. IC 566 – VCO Applications.
13. 4 bit DAC using OP AMP.

Equipment required for Laboratories:

1. RPS
2. CRO
3. Function Generator
4. Multi Meters
5. IC Trainer Kits (Optional)
6. Bread Boards
7. Components:- IC741, IC555, IC565, IC1496, IC723, 7805, 7809, 7912 and other essential components.
8. Analog IC Tester

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III Year – II Semester

L	T	P	C
3	0	0	0

VALUE EDUCATION

Course Objectives:

Students will be able to

1. Understand value of education and self-development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course outcomes:

Students will be able to have

2. Knowledge of self-development
3. Learn the importance of Human values 3.Developing the overall personality

Syllabus

Unit	Content	Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline	4
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking.	4
4	Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature	4
5	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence , Humility, Role of Women.	4
6	All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	4

Suggested reading:

1 Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, NewDelhi

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IV Year – I Semester

L	T	P	C
3	0	0	3

SWITCHGEAR AND PROTECTION

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2	--	--	--	--	--	--	--	--	2	2	1
CO2	2	3	2	2	--	--	--	--	--	--	--	--	3	2	1
CO3	2	3	2	2	--	--	--	--	--	--	--	--	3	2	1
CO4	2	3	2	2	--	--	--	--	--	--	--	--	2	2	1
CO5	2	3	2	2	--	--	--	--	--	--	--	--	3	2	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

UNIT–III:
Generator Protection

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

Transformer Protection

Percentage differential protection– Design of CT's ratio– Buchholz relay protection– Numerical examples.

UNIT–IV:

Feeder and Bus bar Protection

Over current Protection schemes – PSM, TMS - Numerical examples -Carrier current and three zone distance relay using impedance relays.

Protection of bus bars by using Differential protection.

UNIT–V:

Static and Digital Relays & Protection against over voltage and grounding

Static relays**:** Static relay components– Static over current relays– Static distance relay– block diagram approach of Microprocessor based over current relay.

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

Course Outcomes:

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

- Understand the principles of arc interruption for application to high voltage circuit breakers of air, oil, vacuum, SF_6 gas type.
- Understand the working principle and operation of different types of electromagnetic protective relays.
- Students acquire knowledge of faults and protective schemes for high power generator and transformers.
- Improves the ability to understand various types of protective schemes used for feeders and bus bar protection.
- Understand different types of static relays and their applications.
- Understand different types of over voltages and protective schemes required for insulation co–ordination.

Text Books:

1. Power System Protection and Switchgear by Badri Ram and D.N Viswakarma, Tata McGraw Hill Publications, 2nd edition, 2011.
2. Power system protection- Static Relays with microprocessor applications by T.S.Madhava Rao,Tata McGraw Hill, 2nd edition.

Reference Books:

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

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

IV Year – I Semester

L	T	P	C
3	0	0	3

POWER SYSTEM OPERATION AND CONTROL

Preamble:
This subject deals with Economic operation of Power Systems, Hydrothermal scheduling and modeling of turbines, generators and automatic controllers. It emphasizes on single area and two area load frequency control and reactive power control.

Course Objectives:

- To understand optimal dispatch of generation with and without losses.
- To study the optimal scheduling of hydro thermal systems.
- To study the optimal unit commitment problem.
- To study the load frequency control for single area system with and without controllers
- .To study the load frequency control for two area system with and without controllers
- To understand the reactive power control and compensation of transmission lines.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	1	1	-	-	-	-	-	-	3	3	3
CO2	1	3	3	2	2	1	-	-	-	-	-	-	3	3	3
CO3	1	2	3	1	2	1	-	-	-	-	-	-	3	3	3
CO4	1	2	3	1	2	1	-	-	-	-	-	-	3	3	3
CO5	1	1	2	2	2	1	-	-	-	-	-	-	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

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
Mathematical Formulation – Solution Technique.
Unit Commitment
Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Priority ordering – Dynamic programming.

UNIT–III:
Load Frequency Control-I
Modeling of steam turbine – Generator – Mathematical modeling of speed governing system – Transfer function – Necessity of keeping frequency constant.

Definitions of Control area – Single area control system – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

Proportional plus Integral control of single area and its block diagram representation – Steady state response.

UNIT–IV:
Load Frequency Control-II
Block diagram development of Load Frequency Control of two area system uncontrolled case and controlled case. Tie-line bias control. Load Frequency Control and Economic dispatch control.

UNIT–V:
Compensation in Power Systems
Overview of Reactive Power control – Reactive Power compensation in transmission systems – Advantages and disadvantages of different types of compensating equipment for transmission systems – Load compensation – Specifications of load compensator – compensated transmission lines – Introduction of FACTS devices – Types of FACTS devices - Need of FACTS controllers.

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

- Compute optimal load scheduling of Generators.
- Formulate hydrothermal scheduling and unit commitment problem.
- analyze effect of Load Frequency Control for single area systems
- analyze effect of Load Frequency Control for two area systems
- Describe the effect of reactive power control and compensation for transmission lines.

Text Books:

1. Power Generation, Operation and Control by Allen J Wood, Bruce F WollenBerg 3rd Edition, Wiley Publication 2014.
2. Electric Energy systems Theory – by O.I.Elgerd, Tata McGraw–hill Publishing Company Ltd., Second edition.
2. Modern Power System Analysis – by I.J.Nagrath&D.P.Kothari Tata McGraw Hill Publishing Company Ltd, 2nd edition.

Reference Books:

1. Power System Analysis and Design by J.Duncan Glover and M.S.Sarma., Cengage Learning publications, 5th edition, 2011.
2. Power System Analysis by Grainger and Stevenson, Tata McGraw Hill.
3. Power System Analysis by HadiSaadat – – Tata McGraw–Hill 3rd edition, 2010.
4. Power System stability & control, Prabha Kundur,TMH, 1994.

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	L	T	P	C
IV Year – I Semester	**3**	**0**	**0**	**3**

HVDC TRANSMISSION
(Program Elective –IV)

Preamble:
The increased consumption of electrical energy in the nation requires well transmission facilities. The problems of AC transmission particularly in long distances, leads to the development of DC transmission. The DC Transmission requires conversion from AC to DC and vice versa at the two ends. The physical process of conversion is such that the same station can switch from rectifier to inverter by simple control action, thus facilitating power reversal. Keeping this in view, the course is designed to understand the transmission phenomena of HVDC and its control. The course also describes protection against faults in converters and lines, and transmission of power with Multi terminal HVDC transmission systems.

Course Objectives:
- To study concepts of DC links
- To study three Phase 6-Pulse bridge converter.
- To study concepts of Power factor at HVDC buses
- To study concepts of handling voltage changes at rectifier/inverter end buses.
- To study concepts of static VAR system
- To study types of MTDC system

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	2	3	-	-	-	-	-	3	2	3	1
CO2	3	2	3	1	2	3	-	-	-	-	-	2	2	3	1
CO3	3	2	3	1	2	3	-	-	-	-	-	2	2	3	1
CO4	3	2	3	1	2	2	-	-	-	-	-	3	2	3	1
CO5	3	2	3	1	2	2	-	-	-	-	-	2	2	3	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

Unit-I
DC Power Transmission Technology:
Introduction, Historical Development, Comparison of AC and DC transmission, types of DC links, Existing HVDC Projects in INDIA. Modern Trends in HVDC Technology.

Analysis of HVDC Converters:
Three Phase 6-Pulse bridge converter, simplified analysis, waveform with and without overlap, Current and voltage relationship, Equivalent circuits of converters, Analysis of a 12 pulse converters.

Unit-II
HVDC System Control:
Principles of DC link control, converter control characteristics, constant current and constant extinction angle control, constant ignition angle control, starting and stopping of HVDC link, power control & power reversal in HVDC link.

Unit-III

Converter Faults and Protection:

Converter faults, over voltages in converter station, Surge arrestors, Protection against over voltages and over currents.

Protection against faults in voltage source converter. Smoothing Rector, Transient over voltages for DC line – Protection of DC lines.

UNIT IV:

Reactive Power Control:

Sources of reactive power - Static VAR system – SVC and STATCOM - Reactive power control during transients.

Harmonics & Filters:

Generation of harmonics – Types and design of various AC filters, DC filters – Active Filters.

UNIT V:

Multi Terminal HVDC Systems & DC Circuit Breakers:

Types of MTDC systems - Control and Protection of MTDC system – HVDC insulation – DC line insulators – DC breakers – Characteristics and types of DC breakers.

Course Outcomes:

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

- Study the concepts of HVDC Transmission & their converters
- Study the concepts HVDC system control methods
- Study the concepts of converter faults and protection schemes for converter & lines.
- Study the concepts of reactive power control, hamonics in HVDC systems & design of filters.
- Study types of MTDC system and DC circuit breakers

Text Book

1. K. R. Padiyar, “HVDC Power Transmission Systems Technology and System Interactions”, New Age International (p) Limited, New Delhi, 2003.
2. Edward Wilson Kimbark, “Direct current Transmission”, Wiley Interscience, Vol. I, New York, 1971.

Reference Books

1. Vijay K. Sood, “HVDC and FACTS Controller: Application of Static Converters in power systems”, IEEE Power Electronics and Power Systems series, Kluwer Academic publishers, Boston, First edition January 2004.
2. C. Adamson and N.G. Hingorani, “High voltage DC power Transmission”, Garraway Limited, England, 1960.
3. Mohan, Undeland and Robbins, “Power Electronics Converters, Applications and Design, John Wiley & Son, Inc., 2003.
4. J. Arrialga, “HVDC Transmission”, Peter Peregrinus Ltd., London, 1983.

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IV Year – I Semester

L	T	P	C
3	0	0	3

EHVAC TRANSMISSION(
(Program Elective –IV)

Preamble:
This course gives the essence in the basic concepts of extra high voltage AC transmission. It also emphasis on the behavior of the line parameters for extra high voltages. The voltage gradients of the transmission line conductors gradients, the effect of corona, electrostatic field calculation, travelling wave theory concept, voltage control when the lines carriers extra high voltages and also to minimize power quality issues by using reactive power compensation.

Course Objectives:

- To calculate the transmission line parameters.
- To calculate the field effects on EHV and UHV AC lines.
- To have knowledge of corona, RI and audible noise in EHV and UHV lines.
- To have knowledge of voltage control and compensation problems in EHV and UHV transmission systems.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	1	-	-	-	-	-	-	3	3	3
CO2	3	3	3	1	3	1	-	-	-	-	-	-	3	3	3
CO3	3	3	3	1	3	1	-	-	-	-	-	-	3	3	3
CO4	3	2	3	1	3	1	-	-	-	-	-	-	3	3	3
CO5	3	2	3	1	3	1	-	-	-	-	-	-	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I:
E.H.V. A.C. Transmission, line trends and preliminary aspects, standard transmission voltages – power handling capacities and line losses – mechanical aspects. Calculation of line resistance and inductance: resistance of conductors, temperature rise of conductor and current carrying capacity. Properties of bundled conductors and geometric mean radius of bundle, inductance of two conductor lines and multi conductor lines, Maxwell's coefficient matrix. Line capacitance calculation. capacitance of two conductor line, and capacitance of multi conductor lines, potential coefficients for bundled conductor lines, sequence inductances and capacitances and diagonalization.

UNIT – II:
Calculation of electro static field of AC lines - Effect of high electrostatic field on biological organisms and human beings. Surface voltage Gradient on conductors, surface gradient on two conductor bundle and cosine law, maximum surface voltage gradient of bundle with more than 3 sub conductors, Mangolt formula.

UNIT – III:
Corona : Corona in EHV lines – corona loss formulae – attenuation of traveling waves due to corona – Audio noise due to corona, its generation, characteristics and limits, measurement of audio noise.

UNIT – IV:

Power Frequency voltage control : Problems at power frequency, generalized constants, No load voltage conditions and charging currents, voltage control using synchronous condenser, cascade connection of components : Shunt and series compensation, sub synchronous resonance in series – capacitor compensated lines

UNIT – V:

Reactive power compensating systems: Introduction, SVC schemes, Harmonics injected into network by TCR, design of filters for suppressing harmonics injected into the system, Introduction to STATCOM.

Course Outcomes:

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

- Calculate the transmission line parameters.
- Calculate the field effects on EHV and UHV AC lines.
- Analyze voltage control and compensation problems in EHV and UHV transmission systems.
- Determine the corona, RI and audible noise in EHV and UHV lines.
- Understand reactive power compensation using SVC and TCR

Text Books:

1. Extra High Voltage AC Transmission Engineering – Rakesh Das Begamudre, Wiley Eastern ltd., New Delhi – 1987.
2. EHV Transmission line reference book – Edison Electric Institute (GEC) 1986.

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IV Year – I Semester

L	T	P	C
3	0	0	3

FLEXIBLE ALTERNATING CURRENT TRANSMISSION SYSTEMS
(Program Elective –IV)

Preamble:

Flexible Alternating Current Transmission System controllers have become a part of modern power system. It is important for the student to understand the principle of operation of series and shunt compensators by using power electronics. As the heart of many power electronic controllers is a voltage source converter (VSC), the student should be acquainted with the operation and control of VSC. Two modern power electronic controllers are also introduced.

Course Objectives:

- To learn the basics of power flow control in transmission lines using FACTS controllers
- To explain operation and control of voltage source converter.
- To understand compensation methods to improve stability and reduce power oscillations of a power system.
- To learn the method of shunt compensation using static VAR compensators.
- To learn the methods of compensation using series compensators
- To explain operation of Unified Power Flow Controller (UPFC).

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1	1	--	--	--	2	--	3	3	2
CO2	3	2	1	2	2	--	--	--	--	--	1	1	3	2	2
CO3	3	2	2	2	2	1	1	--	--	--	2	1	3	2	2
CO4	3	2	2	2	2	1	1	--	--	--	2	1	3	2	2
CO5	3	2	3	2	2	--	--	--	--	--	2	1	3	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

Active power filters - Concept of voltage source converter (VSC) – Single phase full wave bridge converter – Square wave voltage harmonics for a single–phase bridge converter – Three–phase full wave bridge converter – Transformer connections for 12, 24 and 48 pulse operation.

Concept of Current Source Converter (CSC), Three–phase current source converter – Comparison of current source converter with voltage source converter.

Unit–III:

Shunt Compensators

Objectives of shunt compensation – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping.

Variable Impedance type VAR generator: Thyristor Switched/Controlled Reactor (TSR/TCR) – Thyristor Switched Capacitor (TSC) – Fixed Capacitor–Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor and Thyristor Controlled Reactor (TSC–TCR), Switching Converter type VAR generator.

Principle of operation and comparison of SVC and STATCOM.

Unit IV:

Series Compensators

Concept of series capacitive compensation – Improvement of transient stability – Power oscillation damping – Functional requirements. GTO thyristor controlled Series Capacitor (GSC) – Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) - Switching Converter type Series Compensation.

Unit–V:

Combined Controllers

Schematic and basic operating principles of unified power flow controller (UPFC) and Interline power flow controller (IPFC) – Application of these controllers on transmission lines.

Course Outcomes:

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

- Know the concepts of facts controller and power flow control in transmission line..
- Demonstrate operation and control of voltage source converter and know the concepts current source converter.
- Analyse compensation by using different compensators to improve stability and reduce power oscillations in the transmission lines.
- Know the concepts methods of compensations using series compensators.
- Analyse operation of Unified Power Flow Controller (UPFC) and Interline power flow controller (IPFC).

Text Books:

1. “Understanding FACTS” N.G.Hingorani and L.Guygi, IEEE Press.Indian Edition is available:—Standard Publications, 2001.

Reference Books:

1. “Flexible ac transmission system (FACTS)” Edited by Yong Hue Song and Allan T Johns, Institution of Electrical Engineers, London.
2. Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.Mohan Mathur and Rajiv k.Varma, Wiley, 2002.

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IV Year – I Semester

L	T	P	C
3	0	0	3

HIGH VOLTAGE ENGINEERING
(Program Elective –IV)

Preamble:
With the growth of power, HV power transmission has become an important subject. The performance of generating equipment requires knowledge of different phenomena occurring at higher voltage. Thus evaluations of various insulating materials are required for protection of HV equipment. Keeping this in view the course is designed to understand various phenomena related to breakdown study and withstand characteristics of insulating materials. The course also describes the generation and measurement of DC, AC and Impulse voltages as well various testing techniques.

Course Objectives:
- To understand the breakdown phenomena in gases, liquids and solids dielectrics.
- To understand the insulating characteristics of dielectric materials.
- To acquaint with the generating principles, operation, design of HVDC, AC, Impulse voltages and currents.
- To understand various techniques for AC, DC and Impulse measurement of high voltages and currents.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	3	3	1	--	--	--	--	2	3	2	3
CO2	2	2	3	3	2	2	1	--	--	--	--	2	3	2	3
CO3	2	2	3	3	2	2	1	--	--	--	--	2	3	2	3
CO4	2	3	3	3	3	2	1	--	--	--	--	2	3	2	3
CO5	3	3	3	3	3	2	1	--	--	--	--	2	3	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT–I:
Break down phenomenon in Gaseous:
Insulating Materials: Types, applications and properties. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases and its limitations – Streamers Theory of break down – Paschen's law- Paschens curve.

UNIT–II:
Break down phenomenon in Liquids:
Liquid as Insulator – Pure and commercial liquids – Breakdown in pure and commercial liquids.
Break down phenomenon in Solids:
Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of composite solid dielectrics.

UNIT–III:
Generation of High DC voltages:
Voltage Doubler Circuit - Voltage Multiplier Circuit – Vande- Graaff Generator.

Generation of High AC voltages:

Cascaded Transformers – Resonant Transformers –Tesla Coil

UNIT–IV:

Generation of Impulse voltages:

Specifications of impulse wave – Analysis of RLC circuit only- Marx Circuit.

Generation of Impulse currents:

Definitions – Circuits for producing Impulse current waves – – Wave shape control - Tripping and control of impulse generators.

UNIT–V:

Measurement of High DC & AC Voltages:

Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps.

Measurement of Impulse Voltages & Currents:

Potential dividers with CRO - Hall Generator - Rogowski Coils.

Course Outcomes:

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

- Be in a position to measure dielectric property of materials used in HV equipment.
- Understand theory of breakdown and withstand phenomenon for gaseous dielectric materials.
- Understand theory of breakdown and withstand phenomenon for liquids & solid dielectric materials.
- Acquaint with the techniques of generation of high AC, DC Impulse voltages and currents.
- Getting knowledge of measurement of high AC, DC, Impulse voltages and currents.

Text Books:

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

Reference Books:

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

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IV Year – I Semester

L	T	P	C
3	0	0	3

UTILIZATION OF ELECTRICAL ENERGY
(Program Elective –IV)

Preamble:

This course primarily deals with utilization of electrical energy generated from various sources. It is important to understand the technical reasons behind selection of motors for electric drives based on the characteristics of loads. Electric heating, welding and illumination are some important loads in the industry in addition to motor/drives. Another major share of loads is taken by Electric Traction. Utilization of electrical energy in all the above loads is discussed in detail in this course. Demand side management concepts are also introduced as a part of this course.

Course Objectives:

- To study the basic principles of illumination and its measurement.
- To understand different types of lightning system including design.
- To acquaint with the different types of heating and welding techniques.
- To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
- To understand the basic principle of electric traction including speed–time curves of different traction services.
- To understand the method of calculation of various traction system for braking, acceleration and other related parameters, including demand side management of energy.
- To understand the concept of various types of energy storage.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	--	--	--	--	--	--	--	2	2	1	2
CO2	3	2	2	2	--	--	--	--	--	--	--	2	2	2	2
CO3	2	2	2	1	--	--	--	--	--	--	--	2	2	1	1
CO4	3	2	2	1	--	--	--	--	--	--	--	2	2	2	1
CO5	1	2	2	1	--	--	--	--	--	--	--	2	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I:
Illumination fundamentals
Introduction, terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light

Various Illumination Methods
Discharge lamps, MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting, Energy conservation.

UNIT – II:
Selection of Motors

Choice of motor, type of electric drives, starting and running characteristics–Speed control–Temperature rise–Applications of electric drives–Types of industrial loads–continuous–Intermittent and variable loads–Load equalization, Introduction to energy efficient motors.

UNIT – III:

Electric Heating

Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding

Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding

UNIT – IV:

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. 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-Numerical problems.

UNIT – V:

Introduction to energy storage systems

Need for energy storage, Types of energy storage-Thermal, electrical, magnetic and chemical storage systems, Comparison of energy storage technologies-Applications.

Course Outcomes:

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

- Understand various level of illuminosity produced by different illuminating sources. And to estimate the illumination levels produced by various sources to design different lighting systems by taking inputs and constraints in view.
- Identify a suitable motor for electric drives and industrial applications.
- Identify most appropriate heating or welding techniques for suitable applications.
- Determine the speed/time characteristics of different types of traction motors.
- Know the necessity and usage of different energy storage schemes for different applications.

Text Books:

1. Utilization of Electric Energy – by E. Openshaw Taylor, Orient Longman.
2. Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai& Sons.
3. “Thermal energy storage systems and applications”-by Ibrahim Dincer and Mark A.Rosen. John Wiley and Sons 2002.

Reference Books:

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

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IV Year – I Semester

L	T	P	C
3	0	0	3

SMART GRID TECHNOLOGIES
(Program Elective –V)

Preamble:
Basic knowledge on smart concept communication protocols, renewable energy systems and electronic circuits.

Course Objectives:

- To understand concept of smart grid and developments on smart grid.
- To understand smart grid technologies and application of smart grid concept in hybrid electric vehicles etc.
- To have knowledge on smart substations, feeder automation and application for monitoring and protection.
- To have knowledge on micro grids and distributed energy systems.
- To know power quality aspects in smart grid.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	--	--	--	--	--	--	--	--	--	1	1	2
CO2	1	2	2	--	--	--	--	--	--	--	--	--	1	1	3
CO3	2	2	--	2	1	--	--	--	--	--	--	--	1	2	2
CO4	2	2	--	2	--	--	--	--	--	--	--	--	1	1	3
CO5	2	2	--	2	1	--	--	--	--	--	--	--	1	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit-I:
Introduction to Smart Grid
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

Unit-II:
Smart Grid Technologies: Part 1
Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers, Net Metering.

Unit-III:
Smart Grid Technologies: Part 2
Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Smart storage like Battery Energy Storage Systems (BESS), Super Conducting Magnetic Energy Storage Systems (SMES), Pumped Hydro, Compressed Air Energy Storage (CAES), Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

Unit-IV:

Micro grids and Distributed Energy Resources

Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid, Integration of renewable energy sources, Demand Response.

Unit-V:

Power Quality Management in Smart Grid

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

Information and Communication Technology for Smart Grid

Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Course Outcomes:

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

- Analyze & understand the smart grid, smart grid policies and its developments.
- Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
- Investigate various smart substations, feeder automation, GIS etc.
- Adapt the micro grids and distributed generation systems.
- Analyze the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.

Text Books:

1. Integration of Green and Renewable Energy in Electric Power Systems,by Ali Keyhani, Mohammad N. Marwali, Min Dai Wiley, 2009.
2. The Smart Grid: Enabling Energy Efficiency and Demand Response, by Clark W. Gellings,Fairmont Press, 2009.
3. Smart Grid: Technology and Applications, by Janaka B. Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Wiley publishers, 2012.
4. Smart Grids by Jean-Claude Sabonnadière, NouredineHadjsaïd, Wiley publishers, 2013.
5. Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities, by Peter S. Fox Penner, Island Press; 1st edition, 8 Jun 2010
4. Microgrids and Active Distribution Networks by S. Chowdhury, S. P. Chowdhury, P.Crossley, Institution of Engineering and Technology, 30 Jun 2009
5. Smart Grids (Power Engineering)by Stuart Borlase CRC Press.

Reference Books:

1. The Advanced Smart Grid: Edge Power Driving Sustainability:1 by Andres Carvallo, John Cooper, Artech House Publishers July 2011
2. Control and Automation of Electric Power Distribution Systems (Power Engineering) by James Northcote, Green, Robert G. Wilson , CRC Press, 2017.

3. Substation Automation (Power Electronics and Power Systems) by Mladen Kezunovic, Mark G. Adamiak, Alexander P. Apostolov, Jeffrey George Gilbert , Springer, 2010.

4. Electrical Power System Quality by R. C. Dugan, Mark F. McGranghan, Surya Santoso, H. Wayne Beaty, McGraw Hill Publication, 2nd Edition.
5. Communication and Networking in Smart Grids by Yang Xiao, CRC Press, 2012.

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IV Year – I Semester

L	T	P	C
3	0	0	3

POWER SYSTEM DEREGULATION
(Program Elective –V)

Preamble:
This course is developed to know the operation of deregulated electricity market systems, various types of electricity market and control issues using new mathematical models. And also to analyze the impact of ancillary services.

Course Objectives:
- To provide in-depth understanding of operation of deregulated electricity market systems.
- To examine typical issues in electricity markets and how these are handled world – wide in various markets.
- To enable students to analyze various types of electricity market operational and control issues using new mathematical models.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	3	3	2	2	2	3	3	3	2	3	2	3
CO2	2	2	2	3	2	2	3	2	2	2	2	3	3	2	2
CO3	3	2	3	2	3	2	2	2	2	3	2	2	3	2	3
CO4	2	3	2	3	2	2	2	2	2	2	2	2	3	2	2
CO5	2	3	2	3	3	2	2	3	2	3	3	3	2	2	3

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT – I:
Need and conditions for deregulation. Introduction of Market structure, Market Architecture, Spot market, forward markets and settlements. Review of Concepts marginal cost of generation, least-cost operation, incremental cost of generation. Power System Operation, Power Exchange.

UNIT – II:
Electricity sector structures and Ownership /management, the forms of Ownership and management. Different structure model like Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model, Definition of Available Transfer Capability (ATC), computation of ATC.

UNIT – III:
Framework and methods for the analysis of Bilateral and pool markets, LMP based markets.

Auction models and price formation, price based unit commitment, country practices.

UNIT – IV:
Transmission network and market power. Power wheeling transactions and marginal costing, transmission costing. Congestion management methods- market splitting, counter-trading; Effect of congestion on LMPs- country practices.

UNIT – V:

Ancillary Services and System Security in Deregulation. Classifications and definitions, AS management in various markets- country practices. Technical, economic, & regulatory issues involved in the deregulation of the power industry.

Course Outcomes:

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

- Understand of operation of deregulated electricity market systems
- Typical issues in electricity markets
- Analyze various types of electricity market operational and control issues using new mathematical models.
- Understand LMP's wheeling transactions and congestion management.
- Analyze impact of ancillary services.

Text Books:

1. Power System Economics: Designing markets for electricity - Steven Stoft , wiley publishers, 2002.
2. Operation of restructured power systems - K. Bhattacharya, M.H.J. Bollen and J.E. Daalder, Springer,2012.

Reference Books:

1. Power generation, operation and control, -J. Wood and B. F. Wollenberg, Wiley, 1998.
2. Market operations in electric power systems - M. Shahidehpour, H. Yaminand Z. Li,Wiley, 2003.
3. Fundamentals of power system economics - S. Kirschen and G. Strbac, Wiley, 2nd edition, 2018.
4. Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry - N. S. Rau, IEEE Press series on Power Engineering.
5. "Competition and Choice in Electricity" by Sally Hunt and Graham Shuttleworth, Wiley publishers, 1997.

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IV Year – I Semester

L	T	P	C
3	0	0	3

HYBRID ELECTRIC VEHICLES
(Program Elective –V)

Preamble:
This course aims to study and understand merits of electric and hybrid electric vehicles. It also deals with different power electronic converters and battery storage systems for electric and hybrid electric vehicles.

Course Objectives:
- To familiarize the students with the need and advantages of electric and hybrid electric vehicles.
- To know various architectures of hybrid electric vehicles.
- To understand the power management of plug in electric vehicles.
- To study and understand different power converters used in electrical vehicles.
- To familiarize with different batteries and other storage systems.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	--	--	2	3	1	1	--	--	--	3	1	1	--
CO2	2	1	1	--	2	1	1	--	--	--	--	2	1	2	2
CO3	3	2	2	2	1	--	1	--	--	--	1	1	3	2	2
CO4	3	3	3	2	2	--	1	--	--	--	--	--	3	3	2
CO5	2	1	1	--	--	--	2	--	--	--	2	3	1	1	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT– I:

Introduction
Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles, advantages and applications of Electric and Hybrid Electric Vehicles, different Motors suitable for of Electric and Hybrid Electric Vehicles.

UNIT–II:

Hybridization of Automobile
Architectures of HEVs, series and parallel HEVs, complex HEVs.Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.

UNIT–III:

Plug-in Hybrid Electric Vehicle
PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs.

Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT–IV:

Power Electronics in HEVs

Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, voltage source inverter, current source inverter, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.

UNIT– V:

Energy Sources for HEVs

Energy Storage Parameters; Chemical Energy Sources, types of Chemical Energy Sources, Fuel Cells, types of Fuel Cells, Ultra capacitors; Flywheels - Battery Management Systems (BMS)

Course Outcomes:

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

- Know the concept of electric vehicles and hybrid electric vehicles.
- Familiar with different configuration of hybrid electric vehicles.
- Choose an effective motor for EV and HEV application
- Design the power converters used in hybrid electric vehicles
- Choose different batteries and other energy storage systems.

Text Books

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
3. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.

ResearchBooks:

1. Pistooa G., “Power Sources , Models, Sustanability, Infrstructure and the market”, Elsevier 2008
2. Mi Chris, Masrur A., and Gao D.W., “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.

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IV Year – I Semester

L	T	P	C
3	0	0	3

AI TECHNIQUES AND ITS APPLICATIONS
(Open Elective –II)

Preamble:

This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Course Objectives:

- To understand artificial neuron models & learning methods of ANN.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To understand different modules of fuzzy controller.
- To understand applications of neural networks and fuzzy logic.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	--	--	--	--	--	--	--	2	2	1	2
CO2	2	2	2	2	1	--	--	--	--	--	--	2	2	2	1
CO3	3	2	2	1	--	--	--	--	--	--	--	2	2	2	2
CO4	1	2	1	2	--	--	--	--	--	--	--	2	2	1	2
CO5	3	2	2	2	1	--	--	--	--	--	--	2	2	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit – I:
Introduction

Artificial Neural Networks (ANN) – Humans and computers – Biological neural networks – ANN Terminology – Models of Artificial neuron – activation functions – typical architectures – biases and thresholds – learning strategy(supervised, unsupervised and reinforced) – Neural networks learning rules. Single layer feed forward neural networks: concept of pattern and its types, perceptron training and classification using Discrete and Continuous perceptron algorithms– linear separability- XOR function.

Unit- II:
ANN Paradigms

Multi-layer feed forward networks –Generalized delta rule– Back Propagation algorithm - Levenberg Marquardt (LM) Algorithm – Radial Basis Function (RBF) network - Kohonen's self-organizing feature maps (KSOFM), Learning Vector Quantization (LVQ)– Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

Unit–III:
Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations

Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT IV:

Fuzzy Logic Modules

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT V:

Applications

Neural network applications: Load flow studies, load forecasting, reactive power control.
Fuzzy logic applications: Economic load dispatch, speed control of DC motors, single area and two area load frequency control.

Course Outcomes:

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

- Know different models of artificial neuron & Use learning methods of ANN.
- Use different paradigms of ANN.
- Classify between classical and fuzzy sets.
- Use different modules of Fuzzy logic controller.
- Apply Neural Networks and fuzzy logic for real-time applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and G.A.Vijayalakshmi Pai – PHI Publication, 2004.

Reference Books:

1. Artificial Neural Network – B.Yegnanarayana, PHI, 2012.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – Mc Graw Hill Inc, 1997.
3. Introduction to Neural Networks using MATLAB 6.0 – S N Sivanandam,SSumathi,S N Deepa TMGH
4. Introduction to Fuzzy Logic using MATLAB – S N Sivanandam,SSumathi,S N Deepa Springer, 2007.

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IV Year – I Semester

L	T	P	C
3	0	0	3

LINEAR CONTROL SYSTEMS
(Open Elective –II)

Preamble:

This course introduces the elements of linear control systems and their analysis. This course covers classical methods of design using frequency response, state space approach for modeling and analysis of LTI systems.

Course Objectives:

- To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function
- To analyze the time response of first and second order systems and improvement of performance by proportional plus derivative and proportional plus integral controllers
- To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
- To formulate state models and analyze the systems. To learn the concepts of Controllability and Observability.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
CO2	2	2	2	2	-	-	-	-	-	-	1	2	2	2	2
CO3	3	3	2	2	-	-	-	-	-	-	1	3	3	2	2
CO4	3	3	3	3	-	-	-	-	-	-	1	3	3	3	2
CO5	2	2	2	2	-	-	-	-	-	-	1	3	2	2	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT- I:

Introduction

Concepts of Control Systems- Open loop and closed loop control systems - examples - differences - Classification of control systems, Feedback characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer function for physical systems.

UNIT- II:

Control Systems Components

Transfer Function of DC & AC Servo motors - Block diagram representation - Block diagram algebra – Representation by signal flow graphs - Reduction using Mason's gain formula.

UNIT -III:

Time Response Analysis

Standard test signals - Time response of first order system – Characteristic equation of feedback control systems.

Transient response of second order system - Time domain specifications – Steady state response - Steady state errors and error constants

UNIT -IV:

Stability Analysis in Frequency Domain

Concept of Stability – Definition of Stability - Routh's Stability Criterion – Qualitative Stability and Conditional Stability –Limitations of Routh's Stability.

Root Locus Technique:

The root locus concept - construction of root loci – simple problems.

UNIT- V:

State Space Analysis of Continuous Systems

Concept of state, state variables and state model, derivation of state models from physical systems, solving the Time invariant state equations- State Transition Matrix and its Properties, concept of controllability and observability.

Course Outcomes:

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

- Derive the transfer function of physical systems
- Determine overall transfer function using block diagram algebra and signal flow graphs.
- Evaluate the time response of first and specifications of second order systems and determine error constants.
- Analyze the absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
- Apply state space analysis concepts to represent physical systems as state models, derive transfer function and determine the response. Understand the concepts of controllability and observability.

Text Books:

1. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International Limited Publishers, 6th edition, 2017.
2. Automatic control system – B.C.Kuo, john wiley and son's, 8th edition, 2003.

Reference Books:

1.Modern control engineering – K.Ogata , prentice Hall of India Pvt. Ltd., 5th Edition, 2015.
2.Control system – N.K.Sinha, New Age International (p) Limited Publishers, 3rd Edition, 1998.
3.Control system engineering – Norman S-Nice, Willey Studio Edition, 4th Edition.
Feedback and control system – Joseph J Distefa.
4.Modern control systems - Richard C. Dorf and Robert H. Bishop, Pearson Prentice Hall Publications, 12th Edition, 2010.

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IV Year – I Semester

L	T	P	C
3	0	0	3

MEASUREMENTS AND INSTRUMENTATION
(Open Elective –II)

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO2	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO3	1	2	3	--	--	--	--	--	--	--	--	--	1	2	--
CO4	1	2	3	2	1	--	--	--	--	--	--	--	1	2	--
CO5	1	2	3	2	1	--	--	--	--	--	--	--	1	2	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

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

for measurement of high resistance, Megger – measurement of earth resistance - Numerical Problems.

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

UNIT – IV:

Transducers

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

UNIT – V:

Digital meters

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

Course Outcomes:

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

- Choose right type of instrument for measurement of ac and dc Electrical quantities.
- Choose right type of instrument for measurement of power and power factor.
- Select right type for measurement of R, L, and C.
- Understand the effectiveness of Transducer.
- Able to understand Digital Meters.

Text Books:

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

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications, 19th revised edition, 2011.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand, 3rd edition.
3. Electrical Measurements by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi–2012.

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IV Year – I Semester

L	T	P	C
0	0	3	1.5

MICROPROCESSORS AND MICROCONTROLLERS LAB

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	--	--	--	--	--	--	1	2	3	2
CO2	3	3	3	3	--	--	--	--	--	--	--	1	2	3	2
CO3	3	2	2	3	1	--	--	--	--	--	--	1	2	3	2
CO4	3	3	3	2	1	--	--	--	--	--	--	1	2	3	2
CO5	3	3	3	3	3	--	--	--	--	--	--	1	2	3	2
CO6	3	3	3	3	--	--	--	--	--	--	--	1	2	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any 10 of the following experiments are to be conducted:

Microprocessor 8086 & Microcontroller 8051:

8086 Microprocessor Programs:

1. Arithmetic operation – Multi byte addition and subtraction, multiplication and division – Signed and unsigned arithmetic operation, ASCII – Arithmetic operation.
2. Logic operations – Shift and rotate – Converting packed BCD to unpacked BCD, BCD to ASCII conversion.
3. Arrange the given array in ascending and descending order
4. Determine the factorial of a given number
5. By using string operation and Instruction prefix**:** Move block, Reverse string Sorting, Inserting, Deleting, Length of the string, String comparison.
6. Find the first and n^{th} number of 'n' natural numbers of a Fibonacci series.
7. Find the number and sum of even and odd numbers of a given array
8. Find the sum of n natural numbers and squares of n natural numbers

Programs on Interfacing:

9. Interfacing 8255–PPI with 8086.
10. Stepper motor control using 8253/8255.
11. Arithmetic operations on 8051
12. Conversion of decimal number to hexa equivalent and hexa equivalent to decimal number
13. Find the Sum of elements in an array and also identify the largest & smallest number of a given array using 8051
14. Reading and Writing on a parallel port using 8051
15. Timer in different modes using 8051
16. Serial communication implementation using 8051
17. Understanding three memory areas of 00 – FF Using 8051 external interrupts.

18. Traffic Light Controller using 8051.

Course Outcomes:

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

- Write assembly language program using 8086 micro based on arithmetic, logical, and shift operations.
- Write assembly language programs for numeric operations and array handling problems.
- Write a assembly program on string operations
- Interface 8086 with I/O and other devices.
- Do parallel and serial communication using 8051 & PIC 18 micro controllers.
- Program microprocessors and microcontrollers for real world applications.

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IV Year – I Semester

L	T	P	C
0	0	3	1.5

POWER SYSTEMS AND SIMULATION LAB

Course Objectives:

To impart the practical knowledge of functioning of various power system components and determination of various parameters and simulation of load flows, transient stability, LFC and Economic dispatch.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO2	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO3	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO4	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2
CO5	2	3	3	2	3	1	-	-	-	-	-	-	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Any of 5 experiments are to be conducted from each section:

Section I: Power Systems Lab

1. Determination of sequence impedances of 3 phase Transformer
2. Determination of sequence impedances of 3 phase Alternator by Fault Analysis
3. Determination of sequence impedances of 3 phase Alternator by Direct method
4. Measurement of ABCD parameters on transmission line model
5. Performance of long transmission line without compensation
6. Performance of long transmission line with shunt compensation
7. Observation of Ferranti effect in long transmission line

Section II: Simulation Lab

8. Determination of Y_{bus} using direct inspection method
9. Load flow solution of a power system network using Gauss-Seidel method
10. Load flow solution of a power system network using Newton Raphson method (Polar)
11. Formation of Z_{bus} by Z_{bus} building algorithm.
12. Economic load dispatch with & without losses
13. Load frequency control of a two area Power System with & without PI controller
14. Transient analysis of single machine connected to an infinite bus (SMIB)

Course Outcomes:

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

- Estimate the sequence impedances of 3-phase Transformer and Alternators
- Evaluate the performance of transmission lines
- Analyze and simulate power flow methods in power systems
- Analyze and simulate the performance of PI controller for load frequency control.
- Analyze and simulate stability studies of power systems

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IV Year – I Semester

L	T	P	C
0	0	2	1

INDUSTRIAL TRAINING /SKILL DEVELOPMENT PROGRAMMES / RESEARCH PROJECT

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IV Year – I Semester

L	T	P	C
0	0	4	2

PROJECT-WORK PHASE -I

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IV Year – I Semester

L	T	P	C
3	0	0	0

UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY

Preamble:

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony" is designed which may be covered in their III or IV semester.
During the Induction Program, students would get an initial exposure to human values through Universal Human Values – I. This exposure is to be augmented by this compulsory full semester foundation course.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	--	--	--	--	2	3	3	--	--	--	--	--	--	--
CO2	--	--	--	--	--	2	3	3	--	--	--	--	--	--	--
CO3	--	--	--	--	--	2	3	3	--	--	--	--	--	--	--
CO4	--	--	--	--	--	2	3	3	--	--	--	--	--	--	--
CO5	--	--	--	--	--	2	3	3	--	--	--	--	--	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. 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
14. Understanding the meaning of Trust; Difference between intention and competence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
21. Holistic perception of harmony at all levels of existence.
    Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional ethics

22. Natural acceptance of human values
23. Definitiveness of Ethical Human Conduct
24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
25. 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.

26. Case studies of typical holistic technologies, management models and production systems
27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

Text Book:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

4. MODE OF CONDUCT (L-T-P-C 2-1-0-3 or 2L: 1T:0P 3 credits)

Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.

Tutorial hours are to be used for practice sessions.

While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.

In the discussions, particularly during practice sessions (tutorials), the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.

Tutorials (experiments or practical) are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions (tutorials) would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.

It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.

This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

5. ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.

Example:

Assessment by faculty mentor:
10 marks Self-assessment: 10 marks
Assessment by peers: 10 marks
Socially relevant project/Group Activities/Assignments:
20 marks Semester End Examination: 50 marks

The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

6. OUTCOME OF THE COURSE:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). 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.

This is only an introductory foundationalinput. It would be desirable to follow it up by

a) faculty-student or mentor-mentee programs throughout their time with the institution
b) Higher level courses on human values in every aspect of living. E.g. as a professional

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IV Year – II Semester

L	T	P	C
3	0	0	3

AI APPLICATIONS IN ELECTRICAL ENGINEERING
(Program Elective –VI)

Preamble:
This course introduces the basics of Neural Networks and essentials of Artificial Neural Networks with Single Layer and Multilayer Feed Forward Networks. Also deals with Associate Memories and introduces Fuzzy sets and Fuzzy Logic system components. The Neural Network and Fuzzy Network system application to Electrical Engineering is also presented. This subject is very important and useful for doing Project Work.

Course Objectives:
- To understand artificial neuron models & learning methods of ANN.
- To utilize different algorithms of ANN.
- To distinguish between classical and fuzzy sets.
- To understand different modules of fuzzy controller.
- To understand applications of neural networks and fuzzy logic.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	--	--	--	--	--	--	1	2	2	2	1
CO2	3	2	2	2	1	--	--	--	--	--	--	2	2	2	2
CO3	2	2	2	2	1	--	--	--	--	--	1	2	2	1	2
CO4	1	2	1	1	--	--	--	--	--	--	--	2	2	2	1
CO5	2	2	2	2	1	--	--	--	--	--	1	2	2	1	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit – I:
Introduction
Artificial Neural Networks (ANN) – Humans and computers – Biological neural networks – ANN Terminology – Models of Artificial neuron – activation functions – typical architectures – biases and thresholds – learning strategy(supervised, unsupervised and reinforced) – Neural networks learning rules. Single layer feed forward neural networks: concept of pattern and its types, perceptron training and classification using Discrete and Continuous perceptron algorithms– linear separability- XOR function.

Unit- II:
ANN Paradigms
Multi-layer feed forward networks –Generalized delta rule– Back Propagation algorithm - Levenberg Marquardt (LM) Algorithm – Radial Basis Function (RBF) network - Kohonen's self organizing feature maps (KSOFM), Learning Vector Quantization (LVQ)– Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

Unit–III:
Classical and Fuzzy Sets
Introduction to classical sets- properties, Operations and relations;

Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT IV:
Fuzzy Logic Modules
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT V:
Applications
Neural network applications: Load flow studies, load forecasting, reactive power control.
Fuzzy logic applications: Economic load dispatch, speed control of DC motors, single area and two area load frequency control.

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

- Know different models of artificial neuron & Use learning methods of ANN.
- Use different paradigms of ANN.
- Classify between classical and fuzzy sets.
- Use different modules of Fuzzy logic controller.
- Apply Neural Networks and fuzzy logic for real-time applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zuarda, Jaico Publishing House, 1997.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by RajasekharanandPai – PHI Publication.

Reference Books:

1. Artificial Neural Network – B.Yegnanarayana, PHI, 2012.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – Mc Graw Hill Inc, 1997.
3. Introduction to Neural Networks using MATLAB 6.0 – S N Sivanandam,SSumathi,S N Deepa TMGH
4. Introduction to Fuzzy Logic using MATLAB – S N Sivanandam,SSumathi,S N Deepa Springer, 2007.

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IV Year – II Semester

L	T	P	C
3	0	0	3

VLSI DESIGN
(Program Elective –VI)

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

CourseObjective:

- To understand MOS and CMOS circuit's features and characteristics.
- To know the fabrication principles of CMOS.
- To understand implementation of CMOS logic circuits.
- To understand Memory design with CMOS family.
- To understand Applications of CMOS circuits.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	--	--	2	2	--	--	--	--	--	--	--	1	--	1
CO2	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--
CO3	--	1	2	--	1	--	--	--	--	--	--	--	--	--	3
CO4	1	--	--	--	--	--	--	--	--	--	--	--	2	1	--
CO5	--	--	2	--	2	--	--	--	--	--	--	--	1	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

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

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

UNIT – V:

Application Specific Integrated Circuits

ASIC - Types of ASICs - Design flow – Design Entry – Simulation – Synthesis – Floor planning – Placement – Routing - Circuit extraction – Programmable ASICs.

Course Outcomes:

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

- Understand the insights of the MOS devices and its characteristics.
- Appreciate the different VLSI process technologies.
- Design the CMOS combinational logic circuits and its layout.
- Develop the sequential circuits and clocking schemes.
- Realize the Design flow of application-specific Integrated circuit.

Text Books:

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

Reference Books:

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

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IV Year – II Semester

L	T	P	C
3	0	0	3

CYBER SECURITY
(Program Elective –VI)

Course Objectives:

- To understand the basic concepts of computer security.
- To protect the web security & operating systems security concepts.
- To understand the basic concepts of cloud computing and security and network security
- To be aware of privacy & management and incidents.
- To know the legal issues and ethics.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	2	2	--	--	--	--	--	--	--	2	1	1
CO2	--	--	2	3	3	--	--	--	--	--	--	--	2	1	1
CO3	--	--	1	3	3	--	--	--	--	--	--	--	2	1	1
CO4	1	2	2	2	2	--	--	--	--	--	--	--	2	1	1
CO5	--	1	2	2	3	--	--	--	--	--	--	--	2	1	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT-I:

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography.

Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

UNIT-II:

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks.

Operating Systems Security: Security in Operating Systems, Security in the Design of Operating
Systems, Rootkit.

UNIT-III:

Network Security: Network Concepts, Threats to Network Communications, Wireless Network
Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management .

Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

UNIT-IV:

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where
the Field Is Headed.

Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster.

UNIT-V:

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Course Outcomes:

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

- Illustrate the broad set of technical, social & political aspects of Cyber Security and security management methods to maintain security protection
- Appreciate the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure
- Illustrate the nature of secure software development and operating systems
- Demonstrate the role security management plays in cyber security defense and legal and social issues at play in developing solutions.

Text Books:

1. Pfleeger, C.P., Security in Computing, Prentice Hall, 2010, 5th edition.
2. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996.

Reference Books:

1. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition,
2. Information Security Management: Concepts and Practice, McGraw-Hill, 2013.
3. Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information
4. Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

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IV Year – II Semester

L	T	P	C
3	0	0	3

ELECTRICAL MACHINE DESIGN
(Program Elective –VI)

Preamble:
This course is enables students to design transformers and rotating machines. Design is the prime job of the engineer. This course will provide insight into fundamentals of electrical machine design.

Course Objectives:
- To understand the basics of design and cooling methods of rotating machines.
- To understand the design of DC machines.
- To understand the design concepts of transformers.
- To understand the design concepts of Induction motor.
- To understand the design concepts of Synchronous machines.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1	--	--	--	1	1	3	2	2
CO2	3	2	2	2	1	1	--	--	--	--	1	--	3	2	2
CO3	3	2	2	2	2	1	--	--	--	--	1	--	3	2	2
CO4	3	2	2	2	2	1	--	--	--	--	1	--	3	2	2
CO5	3	2	2	2	2	1	--	--	--	--	1	--	3	2	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT -I:
Fundamental Aspects of Electrical Machine Design
Design of machines - design factors - limitation in design - modern trends in electrical machine design – types of magnetic and insulating materials – modes of heat dissipation – cooling of rotating machines – methods of cooling.

UNIT -II:
Design of DC Machines
Construction details – design of different windings – output equation –selection of specific magnetic and electric loadings - separation of D and L – estimation of number of conductors, armature slots and conduct dimensions – choice of number of poles and calculation of length of airgap – design of field systems, interpoles and brushes.

UNIT -III:
Design of transformers
Transformer windings – output equation – determination of number of turns and length of mean term – design of core - choice of flux density – resistance and leakage reactance – no load current calculation – losses and efficiency – design of efficiency - cooling of transformers- calculation of number of tubes.

UNIT -IV:

Design of Induction motors

Comparison between squirrel cage and wound rotors – choice of average flux density and ampere conduction for meter – output equation – design of stator slots and rotor slots – design of no load current – dispersion coefficient and its effects on performance of induction motor.

UNIT -V:

Design of Synchronous Machines

Types of construction – output equation - main dimensions – short circuit ration and its effects on the performance – design of rotor – temperature rise and its effects.

Course Outcomes:

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

- Select a proper material for the design of electrical machine.
- Design the output equations of a dc machine with overall dimensions.
- Design a overall transformer further requriements.
- Design of stator core and other characteristics of Induction Motor.
- Design overall dimensions of Synchronous Machine.

Text Books:

1. “Electrical Machine Design”, A.K.Sawhney, Dhanpath Rai & Co.,2016

Reference Books:

1. “Performance and Design of DC Machines”, Clayton & Hancock, ELBS.
2. “Performance and Design of AC Machines”, M.G.Say; Pitman, ELBS.

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IV Year – II Semester

L	T	P	C
3	0	0	3

SWITCH MODE POWER CONVERSION
(Program Elective –VII)

Preamble:
This course deals with analysis and design of switch mode DC-DC power converters. The SMPC is in the center of renewable energy and energy harvesting technologies. This subject is focused on the analysis control and design of Non-isolated, Isolated DC-DC converters and resonant converters that are basic building blocks of various high frequency and high efficiency processors.

Course Objectives:

- To analyse the operation of non-isolated switch mode converters and design them
- To analyze the operation of isolated switch mode converters.
- To understand the operation and control of resonant converters.
- To analyse the control schemes of converters and design transformer and inductor
- To model the converters and design controller for closed loop operation.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	2	2	3	2	2
CO2	3	2	2	1	1	-	-	-	-	-	2	3	3	3	2
CO3	3	2	2	2	1	-	-	-	-	-	2	2	2	2	2
CO4	3	2	2	1	1	-	-	-	-	-	2	3	3	3	2
CO5	3	2	3	2	1	-	-	-	-	-	2	3	3	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT– I:
Non-Isolated Switch Mode Converters:
Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, Converter realization with non-ideal components.

UNIT– II:
Isolated Switched Mode Converters:
Forwarded converter, flyback converter, push-pull converter, half-bridge converter, full bridge converter.

UNIT– III:
Resonant Converters:
Basic resonant circuit concepts, series resonant circuits, parallel resonant circuits, zero current switching quasi-resonant buck converter, zero current switching quasi-resonant boost

converter, zero voltage switching quasi-resonant buck converter, zero voltage switching quasi-resonant boost converter.

UNIT– IV:

Control Schemes Of Resonant Converters:

Voltage control, Current mode control, control scheme for resonant converters.

Magnetic Design: Transformer design, inductor and capacitor design.

UNIT– V:

Modeling and Controller Design Based on Linearization:

Formulation of averaged models for buck and boost converters average circuits models, small – signal analysis and linearization-state space analysis, average switch modelling.

Control design based on linearization: Transfer function of converters, control design, large signal issues in voltage-mode and current-mode control.

Course Outcomes:

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

- Design and analyze the operation of non-isolated switch mode converters
- Analyze the operation of isolated switch mode converters.
- Illustrate the operation of resonant converters.
- Analyze the control schemes of converters and design transformer and inductor
- Model the converters and design controller for closed loop operation.

Text Books:

1. Fundamentals of Power Electronics- Erickson, Robert W., Maksimovic, Dragan, Springer, 2011.
2. Power switching converters- Simon Ang, AlejandroOliva, CRC Press, 2010.
3. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
4. Design of Magnetic Components for Switched Mode Power Converters- Z Umanand, S.P. Bhat, John Wiley& Sons Australia, 1992.

Reference Books:

1. Switching Power Supply Design- Abraham I. Pressman, McGraw-Hill Ryerson, Limited, 1991.
2. Power Electronics – Issa Batareseh, Jhon Wiley publications, 2004.
3. Power Electronics: converters Applications & Design – Mohan, Undeland, Robbins-Wiley publications.

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IV Year – II Semester

L	T	P	C
3	0	0	3

EMBEDDED SYSTEMS
(Program Elective –VII)

Course Objectives:

After going through this course the student will be able to

- Understand the building blocks of typical embedded system and different memory technology and memory types.
- Learn the characteristics of an embedded system, quality attributes of embedded systems, application specific and domain specific embedded system,
- Learn about communication devices and basics about VLSI and integrated circuit design and learn concept of firmware design approaches, ISR concept. Interrupt sources, interrupt servicing mechanism, multiple interrupts,
- Understand the concepts of c versus embedded c and compiler versus cross-compiler.
- Learn about the integrated development environment, software utility tool. Also learn about quality assurance and testing of the design, testing on host machine, simulators.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	--	2	--	--	--	--	--	--	--	--	--	2	--	1
CO2	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--
CO3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	2
CO4	2	--	--	--	1	--	--	--	--	--	--	--	1	2	--
CO5	--	--	2	--	2	--	--	--	--	--	--	--	2	--	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit-I:

Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, The typical embedded system-Core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Embedded firmware, PCB and passive components. Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system, Main processing elements of embedded system, hardware and software partitions.

Unit-II:

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock.

Unit-III:

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

Unit-IV:

Real Time Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Threads, Processes and Scheduling, Task Scheduling, Communication, Synchronization, Device Drivers, How to choose an RTOS. Electronics and Communication Engineering

Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware, ICE.

Unit-V:

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools.

Embedded System Implementation And Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine, Simulators, Laboratory Tools. Test and evolution of an embedded systems(Build in self test etc).

Case study- typical embedded system design flow with an example.

Text Books:

1. Embedded Systems Architecture By Tammy Noergaard, Elsevier Publications, 2005
2. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications.

References:

1. Embedding system building blocks By Labrosse, CMP publishers.

Course Outcomes:

After going through this course the student will be able to

- Know basics of embedded system, classification, memories, different communication interface and what embedded firmware is and its role in embedded system, different system components.
- Distinguish all communication devices in embedded system, other peripheral device.
- Distinguish concepts of C versus embedded C and compiler versus cross-compiler.
- Choose an operating system, and learn how to choose an RTOS

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L	T	P	C
3	0	0	3

PROGRAMMABLE LOGIC CONTROLLERS & its APPLICATIONS
(Program Elective –VII)

Preamble:
With the price reductions and technical advances, applications of PLCS have increased. PLCS are increasingly used to connect and work with other computer and automated systems and components. Use of PLCs has also expanded in safety systems and for redundancy for grater reliability. The groming need for PLC training parallels the expanding market. The latest PLC models have more functions and more networking capabilities, as well as user friendly programming. I response, this subject gives the basic knowledge of PLC components and their functions. And also provide the programming knowledge along with the applications.

Course Objectives:
- To study I/O modules of PLC systems
- To study Boolean algebra system and spray process system
- To study PLC Programming and PLC Registers.
- To study PLC Functions
- To study Data Handling functions.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	3	-	-	-	-	-	3	2	3	1
CO2	3	2	2	1	2	3	-	-	-	-	-	2	2	3	1
CO3	3	2	2	1	2	2	-	-	-	-	-	-	2	3	1
CO4	3	2	2	1	2	2	-	-	-	-	-	-	2	3	1
CO5	3	2	2	1	2	3	-	-	-	-	-	3	2	3	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Week)

UNIT-I:
Introduction to PLC systems:
I/O modules and interfacing, CPU processor, programming Equipment, programming formats, construction of PLC ladder diagrams, Devices connected to I/O modules. Digital logic gates, programming in the Boolean algebra system, conversion examples Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system.

UNIT-II:
PLC Programming: Input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill press operation.
PLC Registers: Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers.

UNIT-III:
PLC Functions: Timer functions & Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT-IV:

Data Handling functions: SKIP, Master control Relay, Jump, Move, FIFO, FAL, ONS, CLR & Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two-axis & three axis Robots with PLC, Matrix functions.

UNIT-V:

Analog PLC operation: Analog modules & systems, Analog signal processing, Multi bit Data Processing, Analog output Application Examples, PID principles, position indicator with PID control, PID Modules, PID tuning, PID functions.

Course Outcomes:

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

- Illustrate I/O modules of PLC systems and ladder diagrams
- Understand PLC Programming and PLC Registers.
- Examine various types of PLC functions and its applications.
- Assess different data handling functions and its applications.
- Describe the analog operations and PID modules.

Textbooks:

1. Programmable Logic Controllers- Principles and Applications by John W. Webb & Ronald A. Reiss, Fifth Edition, PHI

2. Programmable Logic Controllers- Programming Method and Applications – JR.Hackworth &F.D Hackworth Jr. –Pearson, 2004

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L	T	P	C
3	0	0	3

COMMUNICATION SYSTEMS
(Program Elective –VII)

Preamble:
Awareness on the concepts and working of communication blocks is inevitable for an electrical engineering student to excel in smart grid applications.

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Course Objectives:

- To develop a fundamental understanding on communication systems with emphasis on analog and digital modulation techniques.
- To get introduced to the basics of error control coding techniques.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	--	1	--	--	--	--	--	--	--	--	2	--	1
CO2	2	--	--	--	2	--	--	--	--	--	--	--	--	2	--
CO3	--	--	2	--	--	--	--	--	--	--	--	--	2	--	1
CO4	1	2	--	2	--	--	--	--	--	--	--	--	--	2	--
CO5	2	--	1	--	2	--	--	--	--	--	--	--	2	--	1

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

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

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

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

Course Outcomes:

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

- Understand the basics of communication system, analog and digital modulation techniques.
- Apply the knowledge of digital electronics and understand the error control coding techniques.
- Summarize different types of communication systems and its requirements.

Text Books:

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

Reference Books:

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

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L	T	P	C
3	0	0	3

MICROPROCESSORS AND MICROCONTROLLERS APPLICATIONS
(Open Elective –III)

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

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	--	--	--	--	--	--	--	1	3	2	1
CO2	3	1	2	1	--	--	--	--	--	--	--	1	3	3	2
CO3	3	2	3	2	1	--	--	--	--	--	--	1	3	3	2
CO4	3	2	2	2	1	--	--	--	--	--	--	1	3	3	2
CO5	3	1	2	2	3	--	--	--	--	--	--	1	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

UNIT–II:
Minimum and Maximum Mode Operations
Instruction sets of 8086 - Addressing modes – Assembler directives - General bus operation of 8086 – Minimum and Maximum mode operations of 8086 – 8086 Control signal interfacing – Read and write cycle timing diagrams.

UNIT–III:

Microprocessors I/O interfacing
8255 PPI– Architecture of 8255–Modes of operation– Interfacing I/O devices to 8086 using 8255–Interfacing A to D converters– Interfacing D to A converters– Stepper motor interfacing– Static memory interfacing with 8086. Architecture and interfacing of 8251 USART – Architecture and interfacing of 8254 Timer/counter – Architecture and interfacing of DMA controller (8257).

UNIT–IV:

8051 Microcontroller:

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

UNIT– V:

PIC Architecture

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

Course Outcomes:

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

- Know the concepts of the Microprocessor capability in general and explore the evaluation of microprocessors.
- Analyse the instruction sets - addressing modes - minimum and maximum modes operations of 8086 Microprocessors
- Analyse the Microcontroller and interfacing capability
- Describe the architecture and interfacing of 8051 controller
- Know the concepts of PIC micro controller and its programming.

Text Books:

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

Reference Books:

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

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L	T	P	C
3	0	0	3

FUNDAMENTALS OF UTILIZATION OF ELECTRICAL ENERGY
(Open Elective –III)

Preamble:

In the modern society, every engineer is using electrical energy irrespective of their branch of specialization. To provide knowledge about the various electrical energy utilization technologies to non-electrical engineering students this course is developed. In this course, a detailed description about the various sources of electrical energy, illumination requirements and energy conservation, various techniques used for heating & welding applications, and brief description about the electric traction are presented. At the end of the course, an insight in to the importance, techniques, and testing of electrical equipment earthing is also presented.

Course Objectives:

- To know various sources of electrical energy, methods used for generation of electrical energy.
- To study the various types of Illumination equipment, measurement of Illumination, Illumination techniques.
- To know the various technologies used for heating and welding applications using electrical energy.
- To know the various systems of traction, equipment used for traction.
- To understand the importance of earthing, earthing equipment and earthing measurement of electrical equipment.

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	--	1	--	--	1	--	--	--	--	--	--	--	--
CO2	3	3	--	1	--	--	--	--	--	--	--	1	--	--	--
CO3	3	3	--	1	--	--	--	--	--	--	--	--	--	--	--
CO4	3	3	--	1	--	--	--	--	--	--	--	--	--	--	--
CO5	3	3	--	1	--	--	1	--	--	--	--	1	--	--	--

(Please fill the above with Levels of Correlation, viz., L, M, H)

Unit-I:

Sources of Electrical Energy

Conventional Sources: Schematic & description of components of thermal power plant - hydroelectric power station and nuclear power plants.

Non-conventional sources: schematic and description of components - Solar power generation - Wind power generation –Small Hydro - Geo-Thermal - Fuel cells technology.

Unit-II:

Illumination

Introduction, source of light, term used in illumination - Lux meter - Discharge lamp - MV and SV lamps - types and design of light as flood light - LED light - shed lighting and domestic light - conservation of energy.

Unit-III:

Heating and Welding

Advantages of Electric heating - types of electric heating - Resistance Heating - properties of heating element - direct heating - indirect heating - Induction heating - Factors effecting heat – Characteristics – application - description of direct core - vertical core - indirect core and core less type of Induction heating.

Dielectric heating – applications of dielectric heating. Advantages of dielectric heating – arc furnace – direct arc furnace – indirect arc furnace.

Welding: Introduction - Resistance welding – Spot welding – Projection welding –Seam welding – Butt welding – Arc welding – Metal arc welding – Helium arc welding – carbon arc welding – Hydrogen arc welding.

Unit IV:

Traction

Introduction – Advantages and disadvantages - systems of traction – classification – speed-time curve for different service – various factors affecting the energy consumption – components of electric locomotive (for collecting and discharging) – description of each component.

Unit -V:

Grounding

Introduction – earth and safety – nature of an electrode system – earth conductor sizes – design of earthing electrodes – earthing system – substation earthing mats – earthing practices – earth testing: methodology - earth tester and use

Course Outcomes:

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

- Know the various sources of electrical energy and its generation technologies for conventional and non-conventional energy sources.
- Know various types of illumination equipment, illumination measurement and illumination techniques.
- Learn about various methods used for electrical energy based heating and welding applications.
- Know about the mechanisms, equipment and technology used in the electric traction.
- Understand the importance of electrical earthing, earthing equipment and electrical earthing measurement methods.

Text Books:

1. Electrical Power Systems (Generation, Transmission, Distribution, Protecection and Utilization of Electrical Energy) – Dr. S.L.Uppal and Prof. Sunil S.Rao – Khanna Publisher, 15th edition, 1987.
2. Electric Power Distribution – A. S. Pabla – McGrawHill, 5th edition, 2004.

Reference Books:

1. Generation Distribution and Utilization of Electrical Energy – C.L.Wadhwa- New Age International Publishers- revised 3rd edition.

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L	T	P	C
3	0	0	3

ELECTRICAL ESTIMATION AND COSTING
(Open Elective –III)

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

Course Objectives:

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

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	1	-	-	-	-	-	1	2	2	1	2
CO2	3	1	2	1	2	-	-	-	-	-	1	2	2	1	1
CO3	2	2	1	2	2	-	-	-	-	-	2	1	2	2	2
CO4	3	1	1	2	2	-	-	-	-	-	1	2	2	1	1
CO5	2	2	2	2	2	-	-	-	-	-	1	2	2	1	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

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

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

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

Unit-IV:

Substations

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

Unit-V: Motor control circuits

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

Course Outcomes:

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

- Identify the various electrical apparatus and their interconnections.
- Select suitable electrical supply system and design earthing systems of various electric loads.
- Estimate the cost for installation of wiring for different types of building and small industries.
- Identify the components of electrical substations.
- Design suitable control circuit for starting of three phase induction motor and synchronous motor.

Text Books:

1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers, 2007.

References Books:

1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers, 6th edition, 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta –Kataria SK & Sons, 2013.

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L	T	P	C
0	0	16	8

PROJECT-WORK PHASE -II