Department of Electrical Engineering

TECHNO INDIA UNIVERSITY

WEST BENGAL

CURRICULUM AND SYLLABUS

For

B. TECH

IN

ELECTRICAL ENGINEERING

DEPARTMENT OF ELECTRICAL ENGINEERING

Department of Electrical Engineering

CURRICULUM

Department of Electrical Engineering

1st Semester

S. No.	Code	Course Title	L	T	P	C
1	TIU-ES-UCS-T11101	INTRODUCTION TO PROGRAMMING	3	0	0	3
2	TIU-BS-UMA-T11101	MATHEMATICS I	3	1	0	4
3	TIU-BS-UCH-T11101	CHEMISTRY	3	1	0	4
4	TIU-ES-UCS-L11191	BASIC COMPUTING LAB	0	0	2	1
5	TIU-ES-UCS-L11101	INTRODUCTION TO PROGRAMMING LABORATORY	0	0	3	1.5
6	TIU-BS-UCH-L11101	CHEMISTRY LAB	0	0	3	1.5
7	TIU-ES-UME-L11192	WORKSHOP PRACTICE	0	0	3	1.5
8	TIU-HSM-UEN-S11191	CAREER ADVANCEMENT & SKILL DEVELOPMENT – I COMMUNICATION SKILL	2	0	0	2
9	TIU-HSM-UES-S11191	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
		Total				**19.5**

Department of Electrical Engineering

2nd Semester

S. No.	Code	Course Title	L	T	P	C
1	TIU-ES-UEE-T12101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	4	0	0	4
2	TIU-ES-UCS-T12101	PROBLEM SOLVING USING DATA STRUCTURE	3	0	0	3
3	TIU-BS-UMA-T12101B	MATHEMATICS II B	4	0	0	4
4	TIU-BS-UPH-T12101	PHYSICS	4	0	0	4
5	TIU-ES-UME-T12101	ENGINEERING MECHANICS	3	0	0	3
6	TIU-ES-UCS-L12101	PROBLEM SOLVING USING DATA STRUCTURES LAB	0	0	3	1.5
7	TIU-ES-UEE-L12101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB AND SIMULATION	0	0	3	1.5
8	TIU-ES-UME-L12191	ENGINEERING DRAWING AND GRAPHICS	0	0	3	1.5
9	TIU-BS-UPH-L12101	PHYSICS LAB	0	0	3	1.5
10	TIU-HSM-UEN-S12191	CAREER ADVANCEMENT & SKILL DEVELOPMENT – II COMMUNICATION SKILL	0	0	2	1
11	TIU-HSM-UES-S12191	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
		Total				**26**

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3rd Semester

Sl. No.	Course Code	Course Name	Contact Periods Per Week			Credits
			L	T	P	
Theory						
1	TIU-UEE-T203	Electromagnetic Field Theory		1	0	4
2	TIU-UEE-T205	Electrical Circuit Theory	3	1	0	4
3	TIU-UEE-T207	Analog Electronics	3	0	0	314
4	TIU-UMA-T201	Mathematics-III	3	1	0	4
5	TIU-UMB-T201	Environmental Science (EVS)	2	0	0	2
Practical						
6	TIU-UEE-L207	Analog Electronics Lab	0	0	3	1.5
7	TIU-UEE-L209	Electrical Circuit Theory Lab	0	0	3	1.5
8	TIU-UMA-L203	Mathematics –III Lab (Numerical Methods)	0	0	3	1.5
Sessional						
9	*	Career Advancement And Skill Development	0	0	2	1
10	TIU-UES-S299	Entrepreneurship Skill Development	0	0	2	1
Total Credits						**23.5**

***CASD Bucket for 3rd Semester**		
1	TIU-UEE-S297A	CASD: Fundamentals of AUTOCAD
2	TIU-UEN-S297B	CASD: Foreign Language: French

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4th Semester

Sl. No.	Course Code	Course Name	Contact Periods Per Week			Credits
			L	T	P	
Theory						
1	TIU-UEE-T202	Electrical Machines-I	3	1	0	4
2	TIU-UEE-T204	Electrical Measurement & Measuring Instruments	3	1	0	4
3	TIU-UEE-T208	Signals & Systems	3	1	0	4
4	TIU-UEE-T214	Digital Electronics Circuits	3	0	0	3
5	TIU-UMA-T202	Probability and Statistics	3	0	0	3
Practical						
6	TIU-UEE-L208	Electrical Machines Lab-I	0	0	3	1.5
7	TIU-UEE-L210	Electrical Measurement & Measuring Instruments Lab	0	0	3	1.5
8	TIU-UEE-L214	Digital Electronics Circuits Lab	0	0	2	1
Sessional						
9	*	Career Advancement And Skill Development	0	0	2	1
10	TIU-UES-S298	Entrepreneurship Skill Development	0	0	2	1
Total Credits						**24**

***CASD Bucket for 4th Semester**		
2	TIU-UEN-S298A	CASD: Foreign Language: French
3	TIU-UEE-S298B	CASD: Placement grooming

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5th Semester

Sl. No.	Course Code	Course Name		Contact Periods Per Week			Credits
				L	T	P	
Theory							
1	TIU-UEE-T305	Electrical Power Systems -I		3	1	0	4
2	TIU-UEE-T307	Control Systems Engineering		3	1	0	4
3	TIU-UEE-T309	Electrical Machines – II		3	1	0	4
4	TIU-UEE-T323	Microprocessor and Microcontroller		3	0	0	3
5	TIU-UME-E321B	Elective-I	1. Thermal Engineering	3	0	0	3
	TIU-UEE-E321		2. Object Oriented Programming with C++ and Java				
Practical							
6	TIU-UEE-L323	Microprocessor and Microcontroller Lab		0	0	3	1.5
7	TIU-UEE-L315	Power Systems Lab -I		0	0	3	1.5
8	TIU-UEE-L317	Control Systems Engineering Lab		0	0	3	1.5
9	TIU-UEE-L319	Electrical Machines Lab -II		0	0	3	1.5
Sessional							
10	*	Career Advancement and Skill Development		3	0	0	3
11	TIU-UES-S399	Entrepreneurship Skill Development		0	0	2	1
Total Credits							**28**

***CASD Bucket for 5th Semester**		
1	TIU-UEE-S301A	CASD: Programming Language: C & Python
2	TIU-UEE-S301B	CASD: SAP

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6th Semester

Sl. No.	Course Code	Course Name		Contact Periods Per Week			Credits
				L	T	P	
Theory							
1	TIU-UEE-T302	Electrical Power Systems -II		3	1	0	4
2	TIU-UEE-T308	Digital Signal Processing		3	1	0	4
3	TIU-UEE-T310	Power Electronics		3	1	0	4
4	TIU-UMG-T392	Principle of Management		3	0	0	3
5	TIU-UEE-E316B	Elective-II	1. Instrumentation and Process Control	3	0	0	3
	TIU-UEE-E316		2. Data Structure and Algorithms				
Practical							
6	TIU-UEE-L308	Digital Signal Processing Lab		0	0	3	1.5
7	TIU-UEE-L310	Power Electronics Lab		0	0	3	1.5
8	TIU-UEE-L314	Electrical Power Systems-II Lab		0	0	3	1.5
9	TIU-UEE-L316B	Elective-II	1. Instrumentation and Process Control Lab	0	0	3	1.5
	TIU-UEE-L316		2. Data Structure and Algorithms Lab				
Sessional							
10	*	Career Advancement and Skill Development		0	0	2	1

11	TIU-UES-S398	Entrepreneurship Skill Development	0	0	2	1
Total Credits						**26**

***CASD Bucket for 6th Semester**		
1	TIU-UEE-S302A	CASD: AUTOCAD: Electrical Application
2	TIU-UEE-S302B	CASD: MATLAB Programming & Simulation

7th Semester

Sl. No.	Course Code	Course Name		Contact Periods Per Week			Credits
				L	T	P	
Theory							
1	TIU-UEE-T413	Electric Drives		3	1	0	4
2	TIU-UEE-T415	Power Systems-III		3	1	0	4
3	TIU-UEE-T417	Utilization of Electric power		3	0	0	3
4	TIU-UEE-E411A	Elective-III	1. Special Electrical Machines	3	0	0	3
	TIU-UEE-E411B		2. Web Technologies				
Practical							
5	TIU-UEE-L413	Electric Drives Lab		0	0	3	1.5
Sessional							
6	TIU-UEE-S401	Career Advancement and Skill Development (Digital IC Design & HVDC)		3	0	0	3
7	TIU-UEE-S405	Electrical Machine Design		2	0	0	2
8	TIU-UES-S499	Entrepreneurship Skill Development		0	0	2	2
9	TIU-UEE-P499	Project Work-I		0	0	4	2
10	TIU-UEE-I499	Industrial Training		0	0	4	2
Total Credits							**26.5**

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8th Semester

Sl. No.	Course Code	Course Name		Contact Periods Per Week			Credits
				L	T	P	
Theory							
1	TIU-UMG-T412	Principle of Management		3	0	0	3
2	TIU-UEE-T404	Communication Engineering		3	1	0	4
3	TIU-UEE-E406B	Elective-IV	1. Energy Conservation and Audit	3	0	0	3
	TIU-UEE-E406		2. Machine Learning				
Sessional							
4	TIU-UEE-S400	Career Advancement and Skill Development (PCB Designing)		3	0	0	3
5	TIU-UES-S498	Entrepreneurship Skill Development		0	0	2	2
6	TIU-UEE-P498	Project Work-II		0	0	2	2
7	TIU-UEE-G498	Grand Viva		0	0	2	2
Total Credits							**19**

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SYLLABUS

Department of Electrical Engineering

SEMESTER 1

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.

Department of Electrical Engineering

Course Title: Introduction to Programming	**Subject Code:** TIU-ES-UCS-T11101
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. develop algorithmic problem-solving skills and implement them in C programs.
2. apply modular programming, recursion, and data structures to create interactive C programs.
3. utilize advanced C concepts like structures, pointers, and linked lists for efficient programming.

COURSE OUTCOME:

The student will be able to:

CO1	Analyze algorithmic solutions to problems.	K4
CO2	Construct algorithms using C programming.	K3
CO3	Apply interactive input/output, arithmetic expressions, repetitions, decision-making, and arrays in programs.	K3
CO4	Organize modular C programs using functions, including recursion.	K3
CO5	Categorize programs using structures, unions, pointers, and linked lists.	K4
CO6	Utilize file input and output operations in programs.	K3

COURSE CONTENT:

MODULE 1:	**INTRODUCTION TO C LANGUAGE**	**4 Hours**
Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs.		
MODULE 2:	**CONDITIONAL STATEMENTS AND LOOPS**	**6 Hours**
Decision making within a program Conditions, Relational Operators, Logical Connectives, if statement, if-else statement. Loops: while loop, do while, for loop, Nested loops, Infinite loops, switch statement, Structured Programming.		
MODULE 3:	**ARRAYS**	**6 Hours**
One dimensional arrays: Array manipulation, Searching, Insertion, and Deletion of an element from an array, finding the largest / smallest element in an array; Two dimensional arrays, Addition/ multiplication of two matrices transpose of a square matrix, Null terminated strings as array of characters, Representation sparse matrice.		
MODULE 4:	**FUNCTIONS**	**7 Hours**
Top-down approach of problem solving; Modular programming and functions; Standard Library of C functions; Prototype of a function Formal parameter list, Return Type, Function call, Block structure; Passing arguments to a Function Call by reference, Call by value, Recursive Functions, Arrays as function arguments.		
MODULE 5:	**STRUCTURES AND UNIONS**	**5 Hours**
Structure variables, Initialization, Structure assignment, Nested structure, Structures and Functions, Structures and arrays: Arrays of structures, Structures containing arrays, Unions.		
MODULE 6:	**POINTERS**	**9 Hours**
Address operators, Pointers type declaration, Pointer assignment, Pointer initialization, Pointer arithmetic, Functions and pointers, Arrays and Pointers, Pointer arrays.		
MODULE 7:	**SELF-REFERENTIAL STRUCTURES AND LINKED LISTS**	**3 Hours**

Creation of a singly connected linked list, traversing a linked list, Insertion into a linked list, Deletion from a linked list.		
MODULE 8:	**FILE PROCESSING**	**5 Hours**
Concept of Files, File opening in various modes and closing of a file, Reading from a file, writing onto a file.		
TOTAL LECTURES		**45 Hours**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.
4. Jones, Robin and Stewart, The Art of C Programming, Narosa Publishing House
5. A Kenneth, C Problem solving and Programming, Prentice Hall International.
6. H.Scheldt, C: The Complete Reference, 4th Edition, McGraw Hill

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	3	-	2	-	-	-	-	-	-	-	1	2	-	-
CO2	2	3	2	-	3	-	-	-	-	-	-	1	3	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	1	2	-	-
CO4	2	-	2	-	3	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
CO6	1	-	-	-	2	-	-	-	-	-	-	1	2	-	-
	2.17	2.50	2.00	2.00	2.80	-	-	-	-	-	-	1.00	2.33	-	-

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Course Title: MATHEMATICS I	**Subject Code:** TIU-BS-UMA-T11101
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Analyze and describe the behavior of functions of single and multiple variables, understand sequences and series.
2. Solve systems of linear equations, evaluate eigenvalues and eigenvectors of square matrices.
3. Analyzing differential equations and finding their solutions.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Analyze the behavior and the nature of the curve with calculus of one variable.	K4
CO2	Develop a basic understanding of functions of several variables and their properties.	K4
CO3	Investigate the solutions of system of linear equations using Determinants and Matrices.	K4
CO4	Evaluate Eigen value and vectors of square matrices.	K4
CO5	Examine the nature (viz., convergence, divergence) of sequence and series.	K4
CO6	Analyze differential equations and investigate solutions.	K4

COURSE CONTENT:

MODULE 1:	**Differential Calculus**	**12 Hours**
Differential Calculus (Functions of one variable): Rolle's theorem (statement only), Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature. Differential Calculus (Functions of several variables): Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutatively, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables – Lagrange's method of multipliers.		
MODULE 2:	**Ordinary Differential Equations**	**10 Hours**
Ordinary Differential Equations: Formation of differential equations, First order differential equations - exact, linear and Bernoulli s form, second order differential equations with constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.		

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MODULE 3:	Sequences and Series	8 Hours
Sequences and Series: Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.		
MODULE 4:	**Matrix and Determinant**	**15 Hours**
Matrix and Determinant: Revision of matrix and determinant, rank and nullity, solutions of system of linear equations using Determinants and Matrices; Eigenvalues and eigen vectors, Cayley-Hamilton Theorem, transformation of matrices, adjoint of an operator, normal, unitary, hermitian and skew-hermitian operators, quadratic forms.		
TOTAL LECTURES		**45 Hours**

Books:

1. Higher Engineering Mathematics, B. S. Grewal
2. Advanced Engineering Mathematics, Kreyszig
3. A TextBook of Engineering Mathematics, Rajesh Pandey
4. Engineering Mathematics, B. K. Pal, K. Das

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	2	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	2	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO6	2	3	-	2	-	-	-	-	-	-	-	1	2	1	-
	2.7	2.5	-	2.0	-	-	-	-	-	-	-	1.0	2.0	1.0	-

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Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Chemistry	**Subject Code:** TIU-BS-UCH-T11101
Contact Hours/Week: 3-1-0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

- Impart the basic concept of thermodynamics, chemical kinetics, ionic Equilibria, electrochemistry, stereochemistry, reaction mechanism and chemical bonding and apply the concept in the relevant engineering field of studies.
- Understanding the thermodynamic concept helps in acquiring information regarding the feasibility of any processes.
- Acquire the knowledge of batteries and fuel cell by understanding the basic concepts of electrochemistry.
- Acquire the knowledge of stereochemistry and reaction mechanism helps in understanding the glimpse of the organic reaction pathways.
- Impart the knowledge of various types of bonding, energy distributions in atomic and molecular orbital makes the student easier to understand the technology based on them.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	**Understand** the concept of chemistry (thermodynamics, chemical kinetics, ionic equilibria, electrochemistry, chemical bonding and isomerism along with reaction mechanism) and applying the same in their engineering branch of studies with a special emphasis to environment, public health and safety.	K2
CO2	**Apply** the concept of chemistry to undertake the interdisciplinary research involving the relevant engineering field of studies.	K3
CO3	**Analyze** the purity of procured chemical compounds based on the acquired knowledge of chemistry related to its physical and chemical properties, which shall in turn used as a starting material for industrial application.	K4
CO4	**Analyze** the knowledge of electrochemistry for better understanding problems related to the mechanism of energy production using electrochemical systems.	K4
CO5	**Remember** the principles of chemical bonding to assess different types of molecular interactions present in varieties of materials and justifying the choice of materials for industrial applications for an engineering solution.	K1
CO-6:	**Understand** the basic concept of organic reaction mechanism and interpreting this concept in the practical field of industrial applications.	K2

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COURSE CONTENT:

MODULE 1:	**THERMODYNAMICS**	**10 Hours**
First law of thermodynamics-system, process, Internal Energy, Enthalpy, Concept of reversible and irreversible process, mathematical form of reversible work and irreversible work, Adiabatic reversible expansion, work done in isothermal and adiabatic process, Specific heat capacity, concept of molar specific heat at constant pressure (C_p), molar heat capacity at constant volume (C_v), Relationship between C_P and C_V, Second law of thermodynamics-Carnot cycle, calculating efficiency of machines, entropy, free energy, Gibbs-Helmholtz equation, concept of spontaneous and non-spontaneous process, Maxwell relation, chemical equilibrium.		
MODULE 2:	**CHEMICAL KINETICS**	**6 Hours**
Rate of reactions, factors affecting the rate of reaction, Rate laws, order and molecularity of a reaction, half life period, mechanism of elementary and overall reaction, reversible, consecutive, and parallel reactions, steady state approximation, variation of rate constant with temperature, Arrhenius equation, collision theory, concept of energy barrier, threshold energy, activation energy		
MODULE 3:		**12 Hours**
A.	**ACID-BASE EQUILIBRIA**	**5 Hours**
Strength of acids and bases based on their dissociation constant, Brönsted-Lowry and Lewis concept of acids and bases, Ionic product of water, pH of solutions and pH indicators, Common ion effect, Salt hydrolysis, Buffer solutions, Henderson's equation, Solubility product and its applications.		
B.	**ELECTROCHEMICAL SYSTEM**	**7 Hours**
Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis, Ostwald's dilution law, Electrochemical cells, electrolytic cells, EMF of a cell, Application of EMF measurements, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, fuel cells.		
MODULE 4:	**CHEMICAL BONDING**	**8 Hours**
Concept of ionic bonding, ionization enthalpy, lattice energy and electro negativity and periodic trends. Covalent bond, sigma and pi bonds: the examples of formation of ammonia, nitrogen, ethene, ethyne, and carbon dioxide, Resonance, Co-ordinate or dative covalent bond: the examples of formation of oxy-acids of chlorine, Hydrogen bonding. Valence Shell Electron Pair Repulsion Theory, Hybridization and shapes of molecules, d- orbital splitting in crystal field (Oh, Td), Molecular orbital theory: Qualitative treatment of homo-nuclear diatomic molecules of first two periods, Energy level diagrams, bonding, anti bonding molecular orbital's, bond order, paramagnetism of O_2 molecule.		
MODULE 5:		
A.	**ISOMERISM AND CHIRALITY**	**3 Hours**
Definition and Classification of isomerism – Structural Isomerism, Stereo Isomerism – Geometric isomerism (Cis and Trans only), Optical isomerism, CIP rules, R,S-Configuration		
B.	**REACTION MECHANISM**	**5 Hours**
Concept of Substitution, addition and elimination reactions, concept of homolytic and heterolytic fission, concept of electrophiles and nucleophiles. Inductive, mesomeric, electrometric effects, and hyper-conjugation, leaving group, reaction media, stereo chemical implications, free radicals and polar mechanisms, Nucleophilic substitution at the saturated carbon atom- S^1, S^2, and S^i, mechanism, elimination reaction-E1, E2, and E_1CB		

mechanisms.	
TOTAL LECTURES	**44 Hours**

BOOKS:

1. S. Glasstone, Text Book of Physical Chemistry, Macmillan India Limited.
2. S. Pahari, Physical Chemistry, New Central Book Agency.
3. P. W. Atkins, Physical Chemistry, 6th Edition, Oxford Publishers.
   I. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc.
4. Mark Loudon, Organic Chemistry, 4th Edition, Oxford Publishers.
5. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai, Publishing Company, 16th Edition, 2017
6. Fundamental concept of Inorganic chemistry, volume 3, 2nd edition, by Asim Kumar Das, CBS publishers and distributors Pvt. Ltd.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	2	-	-
CO2	2	3	-	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
CO6	2	2	-	-	-	-	-	-	-	-	-	-	2	2	1
	2.5	2.2	-	2.0	-	2.0	2.0	-	-	-	-	1.0	2.2	2.5	1.0

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Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Basic Computing Lab	**Subject Code:** TIU-ES-UCS-L11191
Contact Hours/Week: 0–0–2	**Credit:** 1

COURSE OBJECTIVE:

Enable the student to:

1. To introduce students to the UNIX/Linux environment and familiarize them with fundamental system operations, commands, and file management techniques.
2. To develop proficiency in shell scripting and command-line utilities for automating tasks, managing processes, and handling files efficiently.
3. To provide hands-on experience with GitHub operations and debugging techniques while enhancing students' ability to work with text processing tools, redirection, and file compression in a UNIX/Linux environment.

COURSE OUTCOME:

The student will be able to:

CO1	Be Familiar with the UNIX/Linux operating system	K2
CO2	Develop proficiency in using shell commands and writing basic shell scripts.	K3
CO3	Understand file systems, process management, and user permissions.	K2
CO4	Understand basic github operations and debugging of programs	K3
CO5	Apply fundamental text processing tools and commands such as grep, find, and text editors (vi/nano) for efficient file manipulation and searching.	K4
CO6	Utilize redirection, piping, and file compression techniques to manage data effectively in a UNIX/Linux environment.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION TO UNIX/LINUX AND BASIC COMMANDS**	**9 Hours**
Overview of UNIX/Linux operating systems, Logging into UNIX/Linux systems, Basic system commands: ls, cd, pwd, cp, mv, rm, clear, man, who, date, cal, etc.		

Understanding the file system hierarchy: /, /home, /bin, /usr, /var, etc.		
MODULE 2:	**FILE AND PROCESS MANAGEMENT**	**9 Hours**
File and Directory Management: Creating, removing, and organizing files and directories, Commands: mkdir, rmdir, touch, chmod, chown, rm, find, etc. Understanding file permissions and ownership (rwx permissions, chmod command) Process Management: Viewing active processes (ps, top, htop), Controlling processes: kill, bg, fg, jobs, nice, and renice, Understanding process states: running, sleeping, zombie		
MODULE 3:	**TEXT PROCESSING AND BASIC SHELL SCRIPTING**	**9 Hours**
Text Editors (vi, nano): Creating, editing, saving, and existing files, Working with commands like grep, cat, more, less, sed, and awk Basic Shell Scripting: Writing simple shell scripts (bash), Understanding variables, loops (for, while), and conditional statements (if, elif, else), Creating automation scripts for file operations and system monitoring		
MODULE 4:	**REDIRECTION, PIPING, AND FILE COMPRESSION**	**9 Hours**
Redirection and Piping: Input/output redirection (>, >>, <) Piping (|) for command chaining File Compression and Archiving: Working with gzip, tar, zip, unzip,Creating and extracting archives for data backup		
MODULE 5:	**GITHUB BASICS AND DEBUGGING TECHNIQUES**	**9 Hours**
Using GitHub for Version Control: Setting up a GitHub repository, Basic commands: git init, git add, git commit, git push, git pull, git clone, checking in and checking out files Debugging Techniques: Identifying and resolving errors in shell scripts, using debugging tools (echo, set -x, gdb for C programs)		
TOTAL LAB HOURS		**45 Hours**

Books:

1. "UNIX and Linux System Administration Handbook" – Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, and Dan Mackin
2. "The Linux Command Line: A Complete Introduction" – William E. Shotts Jr.
3. "Learning the bash Shell"– Cameron Newham.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	1	-	-	-	-	-	-	1	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	1	3	-	2
CO6	1	-	-	-	3	-	-	-	-	-	-	2	2	-	-

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	2.2	2.3	3.0	-	2.4	-	-	-	-	-	-	1.2	2.5	-	2.0

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Introduction to Programming Laboratory	**Subject Code:** TIU-ES-UCS-L11101
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Introduce students to the fundamentals of C programming, including syntax, data types, operators, and control structures, enabling them to write and execute basic programs.
2. Develop students' ability to analyze problems, apply algorithmic thinking, and implement solutions using decision-making constructs, loops, functions, and data structures.
3. Equip students with hands-on experience in using arrays, strings, pointers, structures, and unions, enabling them to develop efficient programs for mathematical computations, data processing, and real-world applications.

COURSE OUTCOME:

CO1	Demonstrate the ability to write, compile, and execute simple C programs using basic input-output functions, arithmetic operations, and control statements.	K2
CO2	Apply conditional statements (if-else, ternary operator, switch-case) and looping constructs (for, while, do-while) to solve mathematical and logical problems.	K3
CO3	Solve mathematical problems such as factorial, permutations & combinations, series summation, and trigonometric computations using C programming.	K3
CO4	Develop programs using arrays and strings to perform operations such as searching, sorting, frequency analysis, and string transformations.	K4
CO5	Utilize pointers, structures, and unions in C to perform complex operations such as matrix manipulations, complex number arithmetic, and data organization.	K4
CO6	Implement user-defined functions and demonstrate the ability to use memory management functions, pointers, and structures for efficient data handling.	K4

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COURSE CONTENT:

MODULE 1:	**Introduction to C Programming & Basic Operations**	**6 Hours**
Writing and executing a basic C program (Hello World). Understanding Input/Output functions (printf(), scanf()). Variables, Data Types, and Memory Allocation. Arithmetic operations and simple mathematical computations		
MODULE 2:	**Control Structures & Decision Making**	**6 Hours**
Conditional statements (if-else, ternary operator, switch-case). Looping constructs (for, while, do-while). Nested control structures.		
MODULE 3:	**Functions, Recursion & Pattern Printing**	**6 Hours**
Defining and calling user-defined functions. Function parameters, return types, and recursion. Printing patterns using loops (*, numbers, alternating 0/1). Mathematical computations using recursion (Factorial, nCr).		
MODULE 4:	**Arrays & Strings**	**9 Hours**
One-dimensional and two-dimensional arrays. Searching & sorting algorithms. String operations (length, frequency analysis, conversion to uppercase/lowercase).		
MODULE 5:	**Pointers, Structures & Memory Management**	**9 Hours**
Pointer concepts and memory addresses. Pointer arithmetic and array manipulation using pointers. Structures and Unions for data organization. Dynamic memory allocation concepts.		
MODULE 6:	**Advanced Programming & Applications**	**9 Hours**
Matrix operations (Addition, Multiplication). Trigonometric function computations (sin, cos values at intervals). File handling concepts (basic read/write operations).		
TOTAL LAB HOURS		**45 Hours**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	-	-	3	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	2	-	-	-	-	-	-	1	3	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO4	2	1	3	-	3	-	-	-	-	-	-	1	2	-	-

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CO5	3	2	-	-	3	-	-	-	-	-	-	1	3	-	2
CO6	2	-	2	-	3	-	-	-	-	-	-	2	3	-	-
	2.3	2.0	2.5	-	2.8	-	-	-	-	-	-	1.2	2.5	-	2.0

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Chemistry Lab	**Subject Code:** TIU-BS-UCH-L11101
Contact Hours/Week: 0-0-3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1.	Understand the safety procedures and follow the protocol while handling chemicals and reagents
2.	Remember the best practices of chemistry lab
3.	Understand to prepare standard operating procedure for each experiment performed
4.	Understand the basic analytical techniques, such as preparation of solutions of desired strength, standardization of solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples using titration and volumetric method.
5.	Analyze the result obtained after performing the experiment
6.	Identify the chemicals in terms of hazardous and non-hazardous nature and also in terms of purity

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	**Remember** the safety protocols and best practices inside a chemistry lab, nature of various types of reagents, handling, and storage.	K1

CO2	**Understand** the basic principle in estimating the pH of solution either by pH meter or conductometric analysis or Potentiometric analysis as well as the basic analytical techniques, such as preparation of solutions of desired strength, standardization of solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples.	K2
CO3	**Apply** the concept of titration in knowing the concentration of unknown acid	K3
CO4	**Evaluate** the functional groups present in organic molecules by simple reactions.	K5
CO5	**Understand** the basics of analyzing various types of organic compounds and their properties	K2
CO6	**Evaluate** the hardness of water by performing the complexometric titration and assess the solubility of different solutes in varied solvents.	K5

COURSE CONTENT:

Experiment	Topic	Contact Hours
Experiment-1:	Acid-base titration involving normality and Molarity as a parameter of standards of solution.	3 Hours
Experiment-2:	Determination of the total hardness of water	3 Hours
Experiment-3:	Determination of the relative viscosity of glycerol solution by Ostwald viscometer.	3 Hours
Experiment-4:	Determination of the relative surface tension of glycerol solution by Stalagmometer	3 hours
Experiment-5:	pH metric and Potentiometric titration	3 hours
Experiment-6:	Qualitative analysis- identification of the following in a given salt: Cations : NH^{4+}, Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Zn^{2+}, Ca^{2+}, and Mg^{2+}	6 hours
Experiment-7:	Qualitative analysis- identification of the following in a given salt: Anions: CO_3^{2-}, NO_2^-, SO_3^{2-}, SO_4^{2-}, NO_3^- etc.	6 hours
Experiment-8:	Identification of the following compounds and functional groups based on observations: Aliphatic compounds: formaldehyde; ethanol; acetic acid; acetone; glucose etc.	6 hours
Experiment-9:	Identification of the following compounds and functional groups based on observations: Aromatic compounds: benzoic acid; phenol; aniline; benzaldehyde etc.	6 hours
Experiment-10:	Determination of the rate kinetic constant value of ester hydrolysis	3 hours
Experiment-11:	Separation of mixtures of organic compounds utilizing the concept of boiling point/melting point/solubility	3 hours
	Total	**45 hours**

BOOKS:

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1. Hands on chemistry laboratory manual by Paradis & Jeffrey, McGraw-Hill publication
2. Experiments in physical chemistry by Garland and Crawl, McGraw-Hill publication

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	-	-	-	-	2	-	2	-	-	-	1	2	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-	1	2	3	-
CO3	2	3	-	-	2	-	-	-	-	-	-	-	2	3	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	3	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO6	3	2	-	2	-	-	-	-	-	-	-	1	3	3	-
	2.3	2.3	-	2.0	2.0	2.0	-	2.0	-	-	-	1.0	2.2	2.8	-

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Workshop Practice	**Subject Code:** TIU-ES-UME-L11192
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

Course Objective:

Enable the students to

- Understand workshop safety and gain knowledge on different materials
- Develop proficiency in using carpentry and fitting shop
- Learn about sheet metal and welding techniques
- Understand the working principles and applications of conventional machines

Course Outcome:

CO1	Demonstrate knowledge of workshop safety and materials used in manufacturing processes.	K1
CO2	Explain the use of carpentry, fitting, and sheet metal tools, and perform basic operations.	K2

CO3	Apply various fitting and machining operations such as measuring, marking, drilling, and tapping.	K3
CO4	Analyze different welding techniques (gas, arc, soldering, brazing) and their applications.	K4
CO5	Evaluate the working principles of conventional machines like lathe, shaper, drilling, grinding, and milling.	K6
CO6	Create joints and structures using woodworking, sheet metal, and welding techniques.	K5

Laboratory Content:

Module-1	**Carpentry Shop: 6 hours** General safety precautions in workshop and introduction. Types of Indian wood used for engineering purposes; Application of timber as per their classification; Carpentry hand tools and machines; Different types of carpentry joints; Different wooden joint preparation.
Module-2	**Fitting Shop: 6 hours** Introduction to fitter's tools, gauges, measuring instruments etc.; Job preparation involving the following operations: measuring and marking, filing, drilling, and tapping.
Module-3	**Sheet metal shop: 3 hours** Introduction, metals used in sheet metal work, hand tools, Sheet metal joints; Soldering.
Module-4	**Welding Shop: 3 hours** Introduction to gas and arc welding; Soldering and brazing etc.; Welding equipment and welding materials.
Module-5	**Machine Shop: 6 hours** Demonstration and working principles of some conventional machines, like lathe, shaper, drilling, grinding, milling machines; General idea of cutting tools of the machines.

TOTAL PRACTICALS
24 hours

Recommended Books:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, **Elements of Workshop Technology** (Vol. – I & II)
2. H S Bawa. ***Workshop Practice,*** McGraw Hill Education; 2nd edition, 2/e
3. Kannaiah, P. and K.L. Narayana (2009), **Workshop Manual**, Scitech Publishers
4. Begeman, M. L. and Amstead, B. H., **Manufacturing Process**, 8th Ed., 1987, Wiley

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)	**PROGRAM SPECIFIC OUTCOMES (PSO)**

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	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	-	-	2	-	2	-	-	-	1	2	-	-
CO2	2	-	-	-	2	-	-	-	-	-	-	-	2	2	-
CO3	2	2	-	-	2	-	-	-	-	-	-	-	3	3	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
CO6	2	2	3	-	2	-	-	-	-	-	-	-	3	3	3
	2.3	2.3	3.0	-	2.0	2.0	-	2.0	-	-	-	1.0	2.5	2.6	3.0

Program: B. Tech. in Electrical Engineering	**Year, Semester:**1st Year, 1st Sem
Course Title: Career Advancement & Skill Development-I Communication Skill	**Subject Code:** TIU-HSM-UEN-S11191
Contact Hours/Week: 2-0-0 (L-T-P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Develop English proficiency for clear, precise, and confident workplace communication.
2. Enhance practical skills in vocabulary, grammar, pronunciation, speaking, and writing.
3. Apply communication theories to improve professional and interpersonal interactions.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Explain fundamental communication principles and their relevance in workplace	K2

	interactions.	
CO2	Apply grammar and language skills to construct precise and coherent spoken and written communication.	K3
CO3	Demonstrate fluency in spoken English through pronunciation drills, vocabulary building, and interactive conversations.	K4
CO4	Construct well-organized sentences, paragraphs, and linked paragraphs to enhance professional writing	K3
CO5	Develop and revise written communication by employing strategies for drafting, editing, and proofreading.	K3
CO6	Assess and refine communication skills to ensure clarity, precision, and confidence in workplace interactions.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION TO COMMUNICATION:** Definition of Communication, Importance of Communication in the Workplace, Introduction to Communication Theory, Elements of Effective Communication, Barriers to Communication, Verbal and Non-Verbal Communication, Role of Culture in Communication.	**5 Hours**
MODULE 2:	**LANGUAGE AND GRAMMAR SKILLS:** Fundamentals of English Grammar, Sentence Structure and Syntax, Parts of Speech, Tenses and their Usage, Common Errors in Grammar, Punctuation and Mechanics, Effective Use of Vocabulary, Word Formation and Usage, Formal vs. Informal Language.	**5 Hours**
MODULE 3:	**SPEAKING SKILLS:** Principles of Effective Speaking, Pronunciation Drills, Sounds of English: Vowels and Consonants, Stress and Intonation, Developing Conversational Skills, Speaking with Clarity and Confidence, Public Speaking Basics, Expressing Opinions and Arguments, Active Listening and Response.	**5 Hours**
MODULE 4:	**WRITING SKILLS:** The Writing Process: Planning, Drafting, Revising, Editing, Writing Effective Sentences and Paragraphs, Paragraph Development and Coherence, Formal and Informal Writing Styles, Writing Emails and Workplace Documents, Writing Reports and Memos, Common Writing Errors and How to Avoid Them	**5 Hours**
MODULE 5:	**PRACTICAL LANGUAGE APPLICATION:** Building Vocabulary through Context, Word Choice and Precision, Constructing Grammatically Correct Sentences, Exercises in Sentence Formation, Pronunciation Drills and Accent Neutralization, Role-Plays and Dialogues, Group Discussions and Debates, Writing and Structuring	**5 Hours**

	Paragraphs, Linking Paragraphs for Coherent Writing.	
MODULE 6:	**PROFESSIONAL COMMUNICATION IN THE WORKPLACE:** Workplace Communication Etiquette, Business Correspondence, Writing Professional Emails, Preparing Presentations, Communicating in Meetings, Handling Workplace Conversations, Persuasive and Negotiation Skills, Overcoming Communication Barriers, Strategies for Effective Workplace Communication.	**5 Hours**
TOTAL LECTURES		**30 Hours**

Books:

1. Sanjay Kumar, Pushp Lata, "Communication Skills", Oxford University Press, 2015, ISBN: 9780199457069
2. M Ashraf Rizvi, "Effective Technical Communication", McGraw Hill Education, 2017, ISBN 9352606108
3. Steven A. Beebe, Susan J. Beebe, and Mark V. Redmond, "Interpersonal Communication: Relating to Others", Pearson, 2013, ISBN-10: 020586273X, ISBN-13: 978-0205862733.
4. Judee K. Burgoon, Laura K. Guerrero, and Kory Floyd, "Nonverbal Communication", Routledge, 2016, ISBN-10: 1138121348, ISBN-13: 978-1138121346.
5. Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, "Interplay: The Process of Interpersonal Communication", Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.
6. Joseph A. DeVito, "The Interpersonal Communication Book", Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.
7. Sarah Trenholm and Arthur Jensen, "Interpersonal Communication", Oxford University Press, 2013, ISBN-10: 0199827504, ISBN-13: 978-0199827503.
8. John Stewart, "Bridges Not Walls: A Book About Interpersonal Communication", McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.
9. Pamela J. Kalbfleisch, "Interpersonal Communication: Evolving Interpersonal Relationships", Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.
10. Mark L. Knapp, John A. Daly, and Frederick P. M. Boster, "Interpersonal Communication Handbook", Sage Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-

CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
	-	-	-	-	-	-	-	-	2.0	2.7	-	-	2.0	-	-

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SEMESTER 2

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Basic Electrical & Electronics Engineering	**Subject Code:** TIU-ES-UEE-T12101
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Aanalyze and describe the basic electrical quantities, circuit elements, and their voltage-current relationships.
2. Design and analyze diode circuits, transistor biasing, and operational amplifier applications.
3. Understand the operation and characteristics of semiconductor devices like diodes, BJTs, JFETs, and MOSFETs.

4. Analyzing differential working principles of single-phase transformers, including voltage transformation and regulation.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Understand Basic Electrical Concepts	K2
CO2	Analyze DC Electrical Networks	K4
CO3	Analyze AC Circuits and Power Systems	K4
CO4	Understand Semiconductor Devices and Applications	K2
CO5	Design and Analyze Analog Circuits	K3
CO6	Understand Transformer Principles and Applications	K2

COURSE CONTENT :

MODULE 1:	Introduction	**4 Hours**
Basic electrical quantities, Voltage, Current, Power. Basic Electrical elements: Resistance, Inductance,Capacitance. Their voltage-current relationship.Voltage and current sources.		
MODULE 2:	DC Network Analysis	**5 Hours**
KCL and KVL and their applications in purely resistive circuits.Concept of linear, bilateral networks. Source conversion, Star-Delta conversion.		
MODULE 3:	DC Network Theorems	**5 Hours**
Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem.		
MODULE 4:	Sinusoidal Steady State Analysis	**5 Hours**
Matrix and Determinant: Revision of matrix and determinant, rank and nullity, solutions of system of linear equations using Determinants and Matrices; Eigenvalues and eigenvectors, Cayley-Hamilton Theorem, transformation of matrices, adjoint of an operator, normal, unitary, hermitian and skew-hermitian operators, quadratic forms.		
MODULE 5:	3-Ph circuits	**5 Hours**
Introduction to 3-Ph quantities.3-ph star and delta connection. Phasor diagram for 3-ph system, Balanced 3-phloads, measurement of 3-ph power.		
MODULE 6:	Semiconductor Devices	**5 Hours**
Energy bands in solids.Intrinsic and extrinsic semiconductors.P-N junctions. Semiconductor diodes: ZenerandVaractor diodes. Bipolar transistors (operation, characteristics).		
MODULE 7:		**4 Hours**
Diode Circuits, BJT biasing & Operation of JFET, MOSFET		
MODULE 8:	OPAMPs	**5 Hours**
Properties of an ideal and a practical OPAMP. Block diagram. Concept of Virtual Short, Inverting and Non-inverting amplifiers, Summing and Differencing amplifier, Differentiator and Integrator.		
MODULE 9:	1-Ph Transformers	**5 Hours**
Faraday's Law, EMF generation (dynamic and static), B-H curve, Construction and operation of single phasetransformer: voltage and current transformation, no-load operation, voltage regulation on resistive		

load.	
TOTAL LECTURES	**43Hours**

Books:

1. D. Chattopadhyay, P. C. Rakshit, Funndamentals of Electric Circuit Theory, S. Chand. Publications
2. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher

Supplementary Reading:

1. Salivahanan and P. Kumar**,** Circuit Theory, Vikas Publishing House
2. Kulshreshtha, Basic Electrical Engineering: Principles and Application, Tata McGraw-Hill.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	2.7	2.3	3.0	-	-	-	-	-	-	-	-	-	2.3	-	-

Program: B. Tech in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Problem Solving using Data Structures	**Subject Code:** TIU-ES-UCS-T12101
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Introduce fundamental data structures such as arrays, linked lists, stacks, queues, and trees, and their role in computational problem-solving.
2. Develop logical and analytical thinking by applying data structures to efficiently store, process, and manipulate data in various programming scenarios.
3. Enhance problem-solving abilities by selecting appropriate data structures based on efficiency, scalability, and real-world applicability.

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COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Recall and describe fundamental data structures, including arrays, linked lists, stacks, queues, and trees.	K1
CO2	Explain searching and sorting techniques, along with their efficiency on different data structures.	K2
CO3	Apply array and linked list operations to solve computational problems.	K3
CO4	Implement stack and queue-based algorithms for expression evaluation and problem-solving scenarios.	K3
CO5	Examine tree-based data structures (Binary Trees, BSTs) and their traversal techniques for problem-solving.	K4
CO6	Compare different data structures based on their efficiency, scalability, and real-world applicability.	K4

COURSE CONTENT:

MODULE 1:	**BASIC CONCEPTS OF DATA REPRESENTATION**	**6 Hours**
Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	**ARRAYS**	**9 Hours**
Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays in Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using Arrays: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.		
MODULE 3	**SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES**	**6 Hours**
Sequential Search, Binary Search, Comparison-based sorting concepts, Bubble Sort, Insertion Sort, Selection Sort.		
MODULE 4	**STACKS AND QUEUES**	**9 Hours**
Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks: Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue: Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.		
Module 5	**Linked Lists**	**6 Hours**
Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List: Reverse the order of elements in a singly linked list, Merge two linked lists into one list.		
Module 6	**Trees**	**9 Hours**
Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its		

Applications.	
TOTAL LECTURE	**45 Hours**

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	1	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	2	-	-	-	-	-	-	1	2	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	1	3	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO6	2	3	-	-	2	-	-	-	-	-	-	2	3	-	2
	2.3	2.4	3.0	-	2.2	-	-	-	-	-	-	1.2	2.5	-	2.0

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: MATHEMATICS II B	**Subject Code:** TIU-BS-UMA-T12101B
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. understand the basics of complex analysis.
2. understand algebraic and geometric representations of vectors and vector spaces and various operations on vector spaces.
3. solve differential equations with series solution method
4. learn the applications of the definite and indefinite integrals.

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COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	analyze complex functions based on analyticity, integrability along a contour, calculus of residue, etc. and its applications in engineering.	K4
CO2	develop an understanding of vector spaces and inner product spaces.	K4
CO3	identify linear transformations on vector spaces and to determine the corresponding matrix representation.	K4
CO4	determine the solution of ordinary differential equations using a series solution method.	K4
CO5	formulate some special functions, namely, Legendre and Bessel functions.	K4
CO6	develop an understanding of Integral calculus and its applications such as determining the area between two curves, the surface of revolution etc.	K4

COURSE CONTENT:

MODULE 1:	**Complex analysis**	**10 Hours**
Complex analysis: Limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, line integrals, Cauchy Goursat theorem (statement only), independence of path, Complex integration over a contour, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals by contour integration.		
MODULE 2:	**Linear algebra**	**10 Hours**
Linear Algebra: Vector spaces over any arbitrary field, linear combination, linear dependence and independence, basis and dimension, linear transformations, matrix representation of linear transformations, linear functional, dual spaces, Inner product spaces, norms, Gram-Schmidt process, orthonormal bases, projections and least squares approximation.		
MODULE 3:	**Series solution of ODE**	**10 Hours**
Series solution of ODE: Review of power series, Ordinary point, regular and irregular singular point, series solution near ordinary and regular singular point. Legendre's equation and Legendre polynomials, Bessel's equation and Bessel's functions.		
MODULE 4:	**Integral calculus**	**8 Hours**
Riemann Integral, fundamental theorem of integral calculus, applications of definite integrals, improper integrals, Beta and Gamma functions, reduction formulae. Double and triple integration, change in order of integration, Jacobian and change of variables formula. Parametrization of curves and surfaces.		
MODULE 5:	**Vector calculus**	**7 Hours**
Vector fields, divergence and curl, Line integrals, Green's theorem, surface integral, Gauss and Stokes' theorems with applications.		
TOTAL LECTURES		**45 Hours**

Books:

1. Higher Engineering Mathematics, *B. S. Grewal*
2. Advanced Engineering Mathematics, *Kreyszig*

3. A Text Book of Engineering Mathematics, *Rajesh Pandey*
4. Engineering Mathematics, *B. K. Pal, K. Das*

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	3.0	2.0	-	-	-	-	-	-	-	-	-	1.0	2.3	2.0	-

Program: B. Tech in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Physics	**Subject Code:** TIU-BS-UPH-T12101
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

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1. Provide a foundational understanding of basic concepts of physics.
2. Develop problem-solving skills and apply the basic concepts of physics in real-world phenomena.
3. Foster critical thinking and analytical skills in applying theoretical knowledge to practical physics problems.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Apply basic concepts of mechanics and acoustics	K3
CO2	Interpret the concepts of physical optics and explain the principles of lasers along with their applications.	K2
CO3	Categorize di electric and magnetic properties of materials leading to Electromagnetic laws and to analyze crystal structure	K4
CO4	Identify the basic properties of conductors, semiconductors, and insulators based on their band structure, and demonstrate their behavior using fundamental band theory concepts.	K3
CO5	Apply the principles of wave-particle duality to analyze physical phenomena followed by basic quantum mechanical calculations	K3
CO6	Classify ensembles and differentiate between classical and Quantum statistical mechanics	K4

COURSE CONTENT:

MODULE 1:	**CLASSICAL MECHANICS**	**5 Hours**
Vector Calculus- gradient of a scaler field, divergence & curl of a vector field with their physical significance; Frame of references, Mechanics of a single particle - conservative and non-conservative forces, Conservation theorems of linear momentum & angular momentum, Conservation law of energy, Potential energy function F= -grad V		
MODULE 2:	**ACCOUSTICS**	**4 Hours**
Harmonic oscillator, Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Attenuation Coefficients of a vibrating system, Forced oscillations and resonance, Mechanical and electrical analogy of forced vibration.		
MODULE 3:	**OPTICS**	**8 Hours**
Interference : Interference of electromagnetic wave, condition for constructive and destructive interferences, position of maximum and minimum on the screen (no deduction), Thin film - conditions for thin film appears bright and dark (No deductions) - Newton's ring Diffraction- Different types of diffraction, Fraunhofer diffraction at single slit (Intensity distribution curve) ,Diffraction pattern in a Multi Slits & plane diffraction grating (no deduction of the intensity for N slits is necessary), Resolving power of a grating (definition & formulae) Polarization of light: Introduction, polarization by reflection - Brewster's law, Malus Law, double refraction, Nicol Prism and its uses, Detection of plane, elliptical and circularly polarized light Lasers: Properties of laser, Spontaneous and Stimulated emission, working principle of laser production, amplification of light by population inversion, Einstein's theory of A and B coefficients; He - Ne laser , applications of lasers.		
MODULE 4:	**ELECTROMAGNETISM**	**5 Hours**
Concept of displacement current, Maxwell field equations and their physical significances, Maxwell field equations for different medium, Maxwell's wave equation & its solution for free space, Electromagnetic		

energy flow & pointing vector		
MODULE 5:	**QUANTUM MECHANICS**	**6 Hours**
Introduction to quantum physics, Wave nature of particles, de Broglie hypothesis, Uncertainty principle, wave functions, concept of probability & probability density, operators, Expectation values. Applications of Schrödinger equation: Schrodinger equation, elementary concepts of particle in a 1D box, quantum harmonic oscillator and Hydrogen atom problem.		
MODULE 6:	**SOLID STATE PHYSICS**	**6 Hours**
Elementary idea of crystal structure –lattice, basis ,unit cell, cubic crystal system, co-ordination number& packing factor, Bragg's law and its importance. Magnetisation- Magnetic permeability and susceptibility, Relation among B,H& M. Types of magnetic materials, Comparative study among them. Hysteresis& importance of hysteresis curve		
MODULE 7:	**STATISTICAL MECHANICS**	**5 Hours**
Qualitative ideas about phase space, macrostates and microstates, density of states, , MB, FD & BE statistics (no deduction necessary), fermions, bosons , Fermi distribution at zero and non – zero temperature.		
MODULE 8:	**SEMICONDUCTOR PHYSICS**	**6 Hours**
Concept of Fermi gas & Free electron theory of metals, Effective mass of an electron & its importance: concept of hole, Classification of materials on the basis of band structure, Intrinsic and extrinsic semiconductors, Effect of temperature on an extrinsic semiconductor, Fermi energy level and its position for intrinsic and extrinsic semiconductors.		
TOTAL LECTURES		**45 Hours**

Books:

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
2. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education private limited
3. Engineering Physics ,Dattuprasad Ramanlal Joshi, McGraw Hill Education private limited
4. A text book on Basic Engineering Physics, A. Chakrabarti, Chhaya prakashani private Ltd.
5. A text book on Integrated Engg. Physics, A. Chakrabarti, Chhaya prakashani private Ltd.
6. A text book on Applied Engineering Physics, Chhaya prakashani private Ltd.
7. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles,Robert Eisberg, Robert Resnick, Wiley
8. Statistical Physics, L.D. Landau, E M.Lifshitz, Butterworth-Heinemann
9. Optics,Ghatak, McGrawHill Education India Private Limited
10. Engineering Physics , Hitendra K Malik & A K Sing, McGraw Hill Education private limited
11. Advanced Acoustics, Dr. D.P. Raychaudhuri, The new bookstall, Revised Ninth Edition, 2009
12. Concepts of Modern Physics (Sixth Edition) by Arthur Beiser (Published by McGraw-Hill).
13. Introduction to Solid State Physics (January2019) by Charles Kittel (Published by Wiley)

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)	PROGRAM

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													SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	2.8	2.2	-	-	-	-	-	-	-	-	-	1.0	2.2	-	-

Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Engineering Mechanics	**Subject Code:** TIU-ES-UME-T12101

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Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. understand the basics of vector mechanics and its applications in engineering mechanics
2. analyze problems in statics
3. analyze problems in dynamics of particles

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	understand the basics of vector mechanics and its application in engineering mechanics.	K2
CO2	understand different force systems and the methods of finding their resultants and to be well-versed with the conditions of equilibrium in 2D.	K2
CO3	apply the laws of static equilibrium in solving problems and perform analysis of statically determinate trusses.	K4
CO4	compute centroids of plane areas, composite areas and to be able to compute area moments of inertias and radii of gyration of plane figures.	K3
CO5	understand basic principles of kinematics of particles, plane, rectilinear and curvilinear coordinate systems and projectile motion	K3
CO6	understand basic principles of kinetics of particles leading to Newton's laws and to be able to apply the work-energy and the linear impulse-linear momentum theorems in solving typical problems	K3

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**4 Hours**
Introduction: Fundamentals of Mechanics: Introduction to mechanics; Basic concepts – mass, space, time and force; Particles and rigid bodies; Scalars and vectors; Free, sliding, fixed and unit vectors; Addition, subtraction and multiplication of two vectors; scalar triple product and vector product of 3 vectors.		
MODULE 2:	**FORCE SYSTEMS AND EQUILIBRIUM**	**9 Hours**
Force systems: Introduction to different force systems; Composition of forces – triangle, parallelogram and polygon law of forces, and addition of two parallel forces; Resolution of forces; Moment of a force, Varignon's theorem; Couples; Force-couple system; Resultant of a force system Equilibrium: Force Systems & Equilibrium: Free body diagram, equilibrium conditions in 2 dimensions, equilibrium of systems involving friction.		
MODULE 3:	**STRUCTURES**	**5 Hours**
Plane Truss: Statically determinate trusses; Force analysis of a truss - method of joints, method of sections		
MODULE 4:	**DISTRIBUTED FORCES**	**7 Hours**
Distributed Forces: Line, area and volume distributions of forces; Centre of gravity; Centre of mass; Centroids of plane figures; Centroids of composite areas. Moment of Inertia: Area moment of inertia; Perpendicular and Parallel axes theorems pertaining to moment of inertia; Radius of gyration.		
MODULE 5:	**KINEMATICS OF PARTICLES**	**8 Hours**
Kinematics of Particles: Differential equations of kinematics – plane, rectilinear and curvilinear motions; Cartesian co-ordinate system; Normal and tangent co-ordinate system, projectile motion.		

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MODULE 6:	KINETICS OF PARTICLES	12 Hours
Kinetics of Particles: Newton's second law of motion; Work and energy principle – gravitational potential energy, elastic potential energy, kinetic energy, power, work-energy theorem, principle of impulse and momentum.		
TOTAL LECTURES		**45 Hours**

Books:

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics (Vol.1 & 2), Wiley India 2017.
2. Shames I. H., Rao G. K. M., Engineering Mechanics, Pearson, 2005.
3. Khurmi R.S. ,A Textbook of Engineering Mechanics, S. Chand, 2018.
4. Bhavikatti S. S, Engineering Mechanics, New Age International Publishers, 2021.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
	3.0	2.2	-	-	-	-	-	-	-	-	-	-	2.2	-	-

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Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Problem Solving using Data Structures Lab	**Subject Code:** TIU-ES-UCS-L12101
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Develop a strong foundation in data structures and algorithms with a focus on both linear and non-linear structures.
2. Implement and analyze searching, sorting, and graph algorithms to optimize problem-solving efficiency.
3. Enhance programming skills by applying data structures in real-world applications and evaluating their complexity.
4. Understand and assess the time and space complexity of algorithms for efficient software development.

COURSE OUTCOME:

The student will be able to:

CO1	Understand fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs along with their applications.	K2
CO2	Implement various data structures using programming techniques to efficiently store, manipulate, and retrieve data.	K3
CO3	Analyze and apply different searching and sorting algorithms to optimize problem-solving.	K4
CO4	Evaluate the time and space complexity of algorithms to improve computational efficiency.	K5
CO5	Apply data structures and algorithms to solve real-world problems and develop efficient software solutions.	K3
CO6	Explore advanced data structures and algorithmic techniques for tackling complex computing challenges.	K6

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**6 Hours**
Basic Concepts of Data Representation: Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	**ARRAY REPRESENTATION**	**6 Hours**
Arrays: Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using Arrays such as the followings: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.		

MODULE 3:	SEARCHING AND SORTING TECHNIQUES	6 Hours
Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Comparison based sorting concept, Bubble sort, Insertion Sort, Selection Sort.		
MODULE 4:	**STACK AND QUEUE**	**9 Hours**
Stacks and Queues: Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks, Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue such as Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.		
MODULE 5:	**LINKED LISTS**	**9 Hours**
Linked Lists: Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List such as Reverse the order of elements in a singly linked list, Merge two linked lists into one list.		
MODULE 6:	**TREE DATA STRUCTURES AND TRAVERSALS**	**9 Hours**
Trees: Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its Applications.		
TOTAL LAB HOURS		**45 Hours**

Books:

1. "Data Structures in C" by Tanenbaum, Moshe J. & Augenstein, PhilipC
2. Gilberg and Forouzan: “Data Structure- A Pseudocode approach with C” by Thomson publication
3. “Fundamentals of Data Structure” (Schaum's Series) Tata-McGraw-Hill.
4. “Fundamentals of data structure in C” Horowitz, Sahani & Freed, Computer Science Press.
5. "Data Structures Using C" by Reema Thareja

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO2	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO3	3	3	-	-	2	-	-	-	-	-	-	1	2	-	-
CO4	3	3	-	-	2	-	-	-	-	-	-	2	2	-	-
CO5	2	2	3	-	3	-	-	-	-	-	-	2	3	-	2
CO6	3	-	-	2	3	-	-	-	-	-	-	2	3	-	3
	2.7	2.5	3.0	2.0	2.5	-	-	-	-	-	-	1.5	2.5	-	2.5

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Program: B. Tech. in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Basic Electrical and Electronics Engineering Lab and Simulation	**Subject Code:** TIU-ES-UEE-L12101
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. introduce fundamental electrical and electronic circuit theorems and develop analytical skills for solving electrical networks.
2. familiarize students with essential circuit components, including R-L-C circuits, diodes, rectifiers, and fluorescent lamps, and their practical applications.
3. enhance hands-on laboratory skills by conducting experiments on circuit analysis, diode characteristics, and rectifier efficiency evaluation.

COURSE OUTCOME:

The student will be able to:

CO1	Identify and understand fundamental electrical and electronic circuit theorems and their applications.	K1
CO2	Explain the working principles of R-L-C circuits, diodes, rectifiers, and fluorescent lamps.	K2
CO3	Apply circuit theorems such as Superposition and Thevenin's Theorem to analyze electrical networks.	K3
CO4	Conduct experiments to measure and analyze V-I characteristics of P-N junction and Zener diodes.	K3
CO5	Evaluate the efficiency and power factor of electrical circuits, rectifiers, and fluorescent lamps.	K4
CO6	Compare different rectifier circuits and analyze their output waveforms and ripple factors.	K4

COURSE CONTENT:

Experiment 1	**Verification of Superposition Theorem**	**5 Hours**
Theoretical foundation of superposition theorem, Application in linear electrical circuits, Step-by-step circuit analysis with multiple voltage/current sources, Practical applications in circuit design,		

troubleshooting, and network analysis.		
Experiment 2	**Study of R-L-C Series Circuit**	**6 Hours**
Characteristics of resistance (R), inductance (L), and capacitance (C) in AC circuits, Impedance (Z) and phase angle, Voltage and current phase relationships, Leading and lagging power factor, Practical applications in circuit analysis and troubleshooting.		
Experiment 3	**Verification of Thevenin's Theorem**	**6 Hours**
Theoretical foundation of Thevenin's theorem, Converting complex circuits into Thevenin equivalent, Measuring Thevenin voltage (Vth) and resistance (Rth), Practical applications in circuit design and network analysis.		
Experiment 4	**Characteristics of Fluorescent Lamp**	**5 Hours**
Gas discharge and phosphor coating in light production, Role of starter, choke (ballast), and electrodes, Measuring voltage, current, and power consumption, Efficiency comparison with incandescent and LED lamps, Impact of inductive ballast on power factor and improvement methods, Performance comparison of electromagnetic vs. electronic ballasts, Energy savings, lifespan, and environmental concerns (mercury content).		
Experiment 5	**Familiarization with Basic Electronic Components**	**6 Hours**
Identification, specifications, and testing of R, L, and C components (Color codes), Potentiometers, switches (SPDT, DPDT, DIP), Breadboards and Printed Circuit Boards (PCBs), Active components: Diodes, BJTs, JFETs, MOSFETs, Power transistors, SCRs, LEDs.		
Experiment 6	**Study of V-I Characteristics of P-N Junction Diode in Forward Bias**	**5 Hours**
Depletion layer and barrier potential, Forward bias operation, Breakdown voltage and Peak Inverse Voltage (PIV), Knee voltage and ideal PN junction diode characteristics.		
Experiment 7	**V-I Characteristics of Zener Diode in Reverse Bias**	**6 Hours**
Depletion layer and barrier potential, Reverse bias operation, Breakdown voltage and Peak Inverse Voltage (PIV), Knee voltage and ideal Zener diode characteristics.		
Experiment 8	**Study of Half-Wave and Full-Wave Rectifier**	**6 Hours**
Half-wave and full-wave rectifiers (Center-tap and Bridge), Output waveforms and voltage regulation, Ripple factor and rectifier efficiency.		
	TOTAL LAB HOURS	**45 Hours**

Books:

1. Boylestad, R. L., & Nashelsky, L. (2015). Electronic devices and circuit theory (11th ed.). Pearson.
2. Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2018). Engineering circuit analysis (9th ed.). McGraw-Hill Education.
3. Sedra, A. S., & Smith, K. C. (2016). Microelectronic circuits (7th ed.). Oxford University Press.
4. Malvino, A. P., & Bates, D. J. (2016). Electronic principles (8th ed.). McGraw-Hill Educatio

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**

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CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	-	-	3	2	-	-	-	-	-	-	-	3	-	-
CO5	2	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO6	2	-	-	3	2	-	-	-	-	-	-	-	3	-	-
	2.3	2.3	-	2.7	2.0	-	-	-	-	-	-	-	2.5	-	-

Program: B. Tech in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Engineering Drawing and Graphics	**Subject Code:** TIU-ES-UME-L12191
Contact hours/week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Develop an understanding of the fundamental concepts and significance of engineering drawing in various engineering disciplines.
2. Acquire skills to construct and analyze engineering curves, projections of points, lines, planes, and solids.
3. Learn to interpret and create orthographic and isometric projections using conventional and computer-aided drafting techniques.
4. Gain proficiency in using drafting software for preparing accurate engineering drawings.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Understand the fundamental principles and scope of engineering drawing across various engineering disciplines.	K2
CO2	Demonstrate proficiency in constructing and analyzing different engineering curves.	K3
CO3	Apply projection techniques for points, lines, planes, and solids in different orientations.	K3
CO4	Develop skills to create orthographic and isometric projections accurately.	K3
CO5	Interpret and convert between pictorial, orthographic, and isometric views of objects.	K6
CO6	Utilize computer-aided drafting tools to create precise engineering drawings.	K6

COURSE CONTENT:

MODULE 1:	**Introduction**	**6 Hours**

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Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Types of Arrowheads, Lines, Dimension System, Representative Fraction, Types of Scales (plain and Diagonal Scale).		
MODULE 2:	**Engineering Curves**	**6 Hours**
Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves (Conics-ellipse; parabola; hyperbola with Tangent and Normal).		
MODULE 3:	**Projection of Points and Straight Lines**	**9 Hours**
Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.		
MODULE 4:	**Projections of Planes and Solids**	**9 Hours**
Projections of various planes (Polygonal, Circular, Elliptical shape inclined to one of the reference planes and two of the reference planes) and Projections of Solids (cube, prism, pyramid, cylinder, cone and sphere).		
MODULE 5:	**Orthographic Projections & Isometric View/Projections**	**8 Hours**
Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection system; Full Sectional Orthographic Views, Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.		
MODULE 6:	**Overview of Computer Aided Drafting Tools**	**1 Hours**
Introduction to Computer Aided Drafting Software; Basic Tools; Preparation of Orthographic Projections and Isometric Views Using Drafting Software.		
TOTAL		**39 Hours**

Books:

Main Reading:
1. Jolhe, Dhananjay A, Engineering Drawing an introduction to AutoCAD, Tata McGraw-Hill.

Supplementary Reading:
N.D. Bhatt, Engineering Drawing, Charotar Publishing House Pvt. Ltd.

Online Content:
1. https://nptel.ac.in/courses/112103019
2. https://nptel.ac.in/courses/112104172

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	3	-	-

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CO4	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	1	-	2	-	3	-	-	-	-	-	-	-	2	-	-
	1.8	1.3	2.7	-	3.0	-	-	-	-	-	-	-	2.3	-	-

Program: B. Tech in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Physics Lab	**Subject Code:** TIU-BS-UPH-L12101
Contact Hours/Week: 0–0–3(L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Provide hands-on experience with experimental techniques in optics, electricity, and mechanics
2. Develop a strong understanding of the fundamental physical constants and properties of materials
3. Enhance students' problem-solving and analytical skills through real-world applications

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Develop hands-on skills in setting up experimental apparatus and accurately measuring physical quantities.	K3
CO2	Analyze experimental data using appropriate methods, interpret results, and assess the reliability and accuracy of measurements.	K4
CO3	Correlate theoretical physics principles with experimental observations to understand real-world applications.	K5
CO4	Demonstrate the ability to troubleshoot experimental issues and make informed decisions to optimize accuracy.	K5
CO5	Document experiments systematically and effectively present results, including calculations and error analysis.	K6
CO6	Work collaboratively in a lab environment, maintaining safety protocols and	K6

	contributing to group discussions and analysis.	

COURSE CONTENT:

EXPERIMENT : 1	**NEWTON'S RING**	**3 Hours**
Determination of wavelength of a monochromatic light by Newton's ring		
EXPERIMENT : 2	**REFRACTIVE INDEX OF WATER**	**3 Hours**
Determination of refractive index of water using travelling microscope		
EXPERIMENT : 3	**HALL COEFFICIENT OF SEMICONDUCTOR**	**3 Hours**
Determination of Hall coefficient of semiconductor		
EXPERIMENT : 4	**CAREY-FOSTER BRIDGE FOR UNKNOWN RESISTANCE**	**3 Hours**
Determine of unknown resistance using Carey-Foster bridge		
EXPERIMENT : 5	**STEFAN'S BOLTZMAN CONSTANT**	**3 Hours**
Determination of Stefan-Boltzmann constant		
EXPERIMENT : 6	**BAND-GAP OF SEMICONDUCTOR**	**3 Hours**
Determination of Band gap of a given semiconductor by four probe method		
EXPERIMENT : 7	**YOUNG'S MODULUS BY FLEXURE METHOD**	**3 Hours**
Determination of Young's modulus of elasticity of the material of a bar by the method of flexure		
EXPERIMENT : 8	**MODULUS OF RIGIDITY BY DYNAMIC METHOD**	**3 Hours**
Determination of modulus of rigidity of the material of a wire by dynamic method		
EXPERIMENT : 9	**COEFFICIENT OF VISCOSITY**	**3 Hours**
Determination of coefficient of viscosity of water by Poiseulle's capillary flow method		
EXPERIMENT : 10	**PLANCK'S CONSTANT USING PHOTOELECTRIC EFFECT**	**3 Hours**
Determination of Plank's constant using photocell		
EXPERIMENT : 11	**THERMOELECTRIC POWER**	**3 Hours**
Determination of thermoelectric power of a given thermo-couple		
Total Hours (Any seven experiments to be performed)		**21 Hours**

Books:

1. Laboratory Manual
2. Advanced Practical Physics (Volume I and II) for BSc Physics Lab, B. Ghosh & K.G Mazumdar
3. An advanced course in practical physics by D . Chattopadhyay and P.C Rakshit, New central agency(P)Ltd.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)	PROGRAM SPECIFIC

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													OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	1	2	-	-	-	-	-	-	-	3	-	-	1	-	-
CO6	-	-	-	-	-	-	2	-	3	2	-	-	-	-	-
	2.0	2.4	-	-	-	-	2.0	-	3.0	2.5	-	1.0	1.8	-	-

Program: B. Tech in Electrical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Career Advancement & Skill Development-II Communication Skill	**Subject Code:** TIU-HSM-UEN-S12191
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit:** 1

COURSE OBJECTIVE:

Enable the student to:

1. Develop fluency in spoken and written English for clear, precise, and confident communication.
2. Train in formal writing, reports, proposals, and multimedia presentations.
3. Strengthen people skills, time management, and analytical reading for workplace success.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	**Explain** fundamental communication principles and **assess** their relevance in workplace interactions.	K2
CO2	**Apply** grammar and language skills to **construct** precise and coherent spoken and written communication	K3
CO3	**Demonstrate** fluency in spoken English through **practicing** pronunciation drills, **developing** vocabulary, and **engaging** in interactive conversations.	K4
CO4	**Construct** well-organized sentences and paragraphs to **enhance** professional writing.	K3
CO5	**Develop** and **revise** written communication by **employing** strategies for drafting, editing, and proofreading	K3
CO6	**Assess** and **refine** communication skills to **ensure** clarity, precision, and	K4

	confidence in workplace interactions.	

COURSE CONTENT:

MODULE 1:	**COMMUNICATION THEORY AND WORKPLACE DYNAMICS:** Definition of Communication, Communication Models, Workplace Communication Strategies, Effective Messaging, Organizational Communication, Cultural Communication, Verbal and Non-Verbal Cues, Barriers to Communication, Interpersonal and Group Communication	5 Hours
MODULE 2:	**ADVANCED LANGUAGE AND GRAMMAR PROFICIENCY:** Morphology and Syntax, Sentence Structuring, Advanced Grammar Rules, Tense Modulation, Phrasal Verbs, Modifiers, Cohesion and Coherence, Lexical Resource, Semantics, Formal vs. Informal Register	5 Hours
MODULE 3:	**STRATEGIC SPEAKING AND ORAL PROFICIENCY:** Phonetics and Phonology, Pronunciation Refinement, Stress and Intonation, Articulation and Clarity, Persuasive Speaking, Argumentation and Debate, Spontaneous Speaking, Interview Techniques, Business Pitches, Active Listening Strategies	5 Hours
MODULE 4:	**PROFESSIONAL AND TECHNICAL WRITING:** Writing Process Methodologies, Text Structuring, Precision in Writing, Report Writing, Business Proposals, Formal Correspondence, Executive Summaries, Editing and Proofreading, Technical Documentation, Press Releases, Persuasive and Analytical Writing	5 Hours
MODULE 5:	**APPLIED LANGUAGE AND COMMUNICATION EXERCISES:** Lexical Expansion, Idiomatic Expressions, Context-Based Learning, Grammar in Context, Role-Plays and Simulations, Speech Analysis, Storytelling Techniques, Collaborative Writing, Dialogues, Workplace Case Studies.	5 Hours
MODULE 6:	**CORPORATE COMMUNICATION AND LEADERSHIP SKILLS:** Professional Etiquette, Negotiation Tactics, Conflict Resolution, Crisis Communication, Leadership and Persuasion, Presentation Design, Cross-Cultural Communication, Media and Public Relations, Digital Communication Ethics, High-Stakes Conversations	5 Hours

TOTAL LECTURES	**30 Hours**

Books:

1. Sanjay Kumar, Pushp Lata, “Communication Skills”, Oxford University Press, 2015, ISBN: 9780199457069
2. M Ashraf Rizvi, “Effective Technical Communication”, McGraw Hill Education, 2017, ISBN 9352606108
3. Sarah Trenholm and Arthur Jensen, “Interpersonal Communication”, Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257
4. Claude G. Théoret, “Advanced Communication Skills: 7 Keys to Personal and Professional Growth”, Independently Published, 2020, ISBN-10: 1656945618, ISBN-13: 978-1656945615..
5. Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, “Interplay: The Process of Interpersonal Communication”, Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.
6. Joseph A. DeVito, “The Interpersonal Communication Book”, Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.
7. Mark L. Knapp and John A. Daly, “The SAGE Handbook of Interpersonal Communication”, SAGE Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.3.

8. John Stewart, “Bridges Not Walls: A Book About Interpersonal Communication”, McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.
9. Pamela J. Kalbfleisch, “Interpersonal Communication: Evolving Interpersonal Relationships”, Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.
10. Deborah Tannen, “Talking from 9 to 5: Women and Men at Work”, William Morrow Paperbacks, 2001, ISBN-10: 0060959622, ISBN-13: 978-0060959623.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												PROGRAM SPECIFIC OUTCOMES (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO-1	-	-	-	-	-	-	-	2	3	2	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO-4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO-6	-	-	-	-	-	-	-	2	2	3	-	-	-	-	-
	-	-	-	-	-	-	-	2.0	2.3	2.8	-	-	-	-	-

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SEMESTER 3

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 3rd Sem
Course Title: Electromagnetic Field Theory	**Subject Code:** TIU-UEE-T203
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for calculation of electric field in various situation.
2. To enable the student to the theoretical basis for calculation of magnetic field in various situation.
3. To enable the student to understand the propagation of electromagnetic wave.
4. To develop the theoretical concepts of electromechanical devices used in industry

COURSE OUTCOME:

On completion of the course, the student will be able to:

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CO-1:	To understand the basic laws of electromagnetism.	K2
CO-2:	To apply the knowledge for calculation of electric and magnetic fields in machine frame.	K3
CO-3:	To analyse time varying electric and magnetic fields and utilize the knowledge for performance improvement of electro-mechanical devices used in industry.	K4
CO-4:	To understand Maxwell's equation in different forms and different media.	K2
CO-5:	To understand the propagation of EM waves.	K2
CO-6:	To create new type of winding for eliminating harmonics and thereby increasing the efficiency of electro-mechanical devices.	K6

COURSE CONTENT:

MODULE 1:	**Review of Vector Calculus**	**9 Hours**
Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.		
MODULE 2:	**Static Electric Field**	**6 Hours**
Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.		
MODULE 3:	**Conductors, Dielectrics and Capacitance**	**6 Hours**
Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.		
MODULE 4:	**Static Magnetic Fields**	**6 Hours**
Biot-Savart Law, Ampere Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.		
MODULE 5:	**Magnetic Forces, Materials and Inductance**	**4 Hours**
Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.		
MODULE 6:	**Time Varying Fields and Maxwell's Equations**	**6 Hours**
Faraday's law for Electromagnetic induction, Displacement current, point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.		
MODULE7:	**Electromagnetic Waves**	**8 Hours**

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Derivation of Wave Equation, Uniform Plane Waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.	
TOTAL LECTURES	**45 Hours**

Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.
3. G S N Raju, "Electromagnetic field theory and Transmission line", Pearson Press, 2019

CO-PO-PSO MAPPING:

CO/ PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	–	2	–	–	–
CO2	3	3	2	–	2	–	–	–	–	–	–	2	2	3	2
CO3	3	3	3	2	3	–	2	–	–	–	2	2	2	3	3
CO4	3	2	–	–	–	–	–	–	–	–	–	2	–	–	–
CO5	3	2	–	–	–	2	2	–	–	–	–	2	1	2	2
CO6	3	2	3	2	3	–	–	–	2	2	2	2	2	3	3
	3.0	2.3	2.7	2.0	2.7	2.0	2.0	-	2.0	2.0	2.0	2.0	1.8	2.8	2.5

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem
Course Title: Electrical Circuit Theory	**Subject Code:** TIU-UEE-T205
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. understand basic electrical properties.

2. analyse electrical circuits by using a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and graphical solution.
3. develop a clear understanding of magnetic circuits, two-port networks, filters and attenuators.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To understand the basic electrical properties of circuits.	K2
CO-2:	To analyse electrical circuits by using a number of powerful engineering circuit analysis techniques such as nodal analysis, mesh analysis, theorems, source transformation and graphical solution.	K4
CO-3:	To analyse time varying currents in a magnetic circuit	K4
CO-4:	To understand and apply concepts of two port network	K3
CO-5:	To analyse various types of filters and attenuators.	K4
CO-6:	To understand function of different circuits as per industrial need and analysing the performance of the circuits.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**16 Hours**
Linear and Nonlinear, Lumped and Distributed, Passive and Active networks, Independent & Dependent sources, Various parameters of a circuit, Network Theorems, Mesh and Node Analysis, Star- Delta conversion, Source conversion., Phasors, Impedance, Reactance Admittance, Impedance triangle, Power triangle, Resonance, Polyphase circuits.		
MODULE 2:	**LAPLACE TRANSFORM**	**4 Hours**
Concept of complex frequency, transform of standard periodic and non-periodic waveforms, Initial and Final value Theorems.		
MODULE 3:	**TRANSIENT ANALYSIS**	**4 Hours**
Transient and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy– solutions in t & s domains, Concept of natural frequency and damping. Sketching transient response, determination of peak values. Practical applications.		
MODULE 4:	**COUPLED CIRCUITS**	**4 Hours**
Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modelling of coupled circuits, Solution of problems.		
MODULE 5:	**GRAPH THEORY**	**4 Hours**
Graph of network, Concept of tree branch, tree link, tie set and cut set, Incidence matrices and their properties, loop currents and node-pair potentials, formulation of equilibrium equations on the loop and node basis, Duality.		
MODULE 6:	**TWO-PORT NETWORKS**	**8 Hours**
Impedance and admittance parameters, transmission and inverse transmission parameters, hybrid and		

inverse hybrid parameters. Series, parallel and cascade connections of two port networks. Elements of realisability and synthesis of one port network.		
MODULE 7:	**FILTER CIRCUITS**	**4 Hours**
Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only)		
MODULE 8:	**NETWORK FUNCTIONS**	**4 Hours**
Introduction, Transfer functions and Driving Point functions, analysis of ladder and non-ladder networks, poles and zeros of Network Functions, Time Domain Response from Pole- Zero Behaviour.		
TOTAL LECTURES		**48 Hours**

Books:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. Bhattacharya and Singh, "Network Analysis and Synthesis", Pearson,
6. A. Chakrabarti, :Circuit Theory: Analysis & Synthesis", S. Chand

References

NPTEL Lecture notes of Electrical Circuit theory conducted by IIT Kanpur

CO-PO-PSO MAPPING:

CO/PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	–	–	–	–	–	–	–	–	–	2	–	2	–
CO2	3	3	2	2	2	–	–	–	–	–	–	2	2	3	2
CO3	3	3	2	2	2	–	1	–	–	–	–	2	2	3	2
CO4	3	3	2	–	2	–	–	–	–	–	–	2	1	2	2
CO5	3	3	3	2	2	–	2	–	–	–	–	2	1	3	3
CO6	3	3	3	2	2	–	2	–	2	2	2	2	2	3	3
	3.0	2.8	2.4	2.0	2.0	-	1.7	-	2.0	2.0	2.0	2.0	1.6	2.7	2.4

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem

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Course Title: Analog Electronics	**Subject Code:** TIU-UEE-T207
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. to expose semiconductor device, performance characteristics and their application.
2. to expose different signal processing techniques and characteristics.
3. to develop an understanding of small signal amplifier design using linear transistor models; and its analysis at low and high frequencies, including different feedback topologies and oscillators.
4. to indulge power amplifiers, tuned amplifiers and behaviour of noise in an amplifier.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the characteristics of transistors.	K2
CO-2:	Design and analyse various rectifier and amplifier circuits.	K3
CO-3:	Design sinusoidal and non-sinusoidal oscillators.	K4
CO-4:	Understand the functioning of OP-AMP and design OP-AMP based circuits.	K3
CO-5:	Design and analysis of different types of power amplifiers and tuned amplifiers.	K2
CO-6:	Behaviour of noise in an amplifier.	K3

COURSE CONTENT:

MODULE 1:	**Diode circuits**	**4 Hours**
P-N junction diode, I-V characteristics of a diode, review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.		
MODULE 2:	**BJT circuits**	**8 Hours**
Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.		
MODULE 3:	**MOSFET circuits**	**8 Hours**
MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.		
MODULE 4:	**Differential, multi-stage and operational amplifiers**	**8 Hours**
Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-ideal op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product).		
MODULE 5:	**Linear applications of op-amp**	**8 Hours**

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Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.		
MODULE 6:	**Nonlinear applications of op-amp**	**6 Hours**
Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.		
TOTAL LECTURES		**42 Hours**

Books:

1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

CO-PO-PSO MAPPING:

CO/PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	–	–	–	–	–	–	–	–	–	2	–	2	–
CO2	3	3	3	2	2	–	–	–	–	–	–	2	2	3	–
CO3	3	3	3	2	2	–	–	–	–	–	–	2	2	3	2
CO4	3	3	3	2	2	–	–	–	–	–	–	2	2	3	2
CO5	3	3	3	2	2	–	–	–	–	–	–	2	2	3	2
CO6	3	2	2	–	–	–	–	–	–	–	–	2	1	2	–
	3.0	2.7	2.8	2.0	2.0	-	-	-	-	-	-	2.0	1.8	2.7	2.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem

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Course Title: Mathematics III	**Subject Code:** TIU-UMA-T201
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. be familiar with numerical methods of solving complicated mathematical problems
2. have an idea about different errors, interpolations and to solve initial value problems
3. study transformations such as Laplace, Fourier transform and their application on solving differential equations

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	develop a concrete knowledge about data, rounding off, significant figures and corresponding errors.	K2
CO-2:	analyse the data and calculate its explicit form via interpolation techniques.	K4
CO-3:	apply integration, differentiation numerically to approximate area under a curve and calculate gradients	K4
CO-4:	compose various numerical techniques to resolve algebraic and transcendental equations, system of equations, initial value problems.	K4
CO-5:	summarise Laplace Transform, Fourier Transform and have a knowledge of Fourier series.	K4
CO-6:	illustrate transform calculus techniques to resolve differential equations.	K4

COURSE CONTENT:

MODULE 1:	**Transform Calculus**	**18 Hours**
UNIT 1: Laplace Transform: Laplace Transform, properties, Inverse, Convolution, Evaluation of some particular integrals by Laplace Transform, Solution of initial value problems. **UNIT 2:** Fourier Series: Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity. **UNIT 3:** Fourier Transform: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem. Applications to boundary value problems.		
MODULE 2:	**Numerical Methods**	**27 Hours**

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UNIT 1: Approximations and round off errors, Truncation errors and Taylor Series. **UNIT 2:** Interpolation – Newton's Forward, Backward, Lagrange's interpolation methods **UNIT 3:** Numerical Integration – Trapezoidal, Simpson's 1/3rd rules. **UNIT 4:** Determination of roots of polynomials and transcendental equations by Bisection, Iteration, Newton-Raphson, Regula-Falsi methods. **UNIT 5:** Solutions of system of linear algebraic equations by Gauss Elimination and Gauss-Seidel iteration methods. **UNIT 6:** Numerical solution of initial value problems by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector methods.

TOTAL LECTURES	**45 Hours**

Books:

1. S. S. Sastry-An Introduction to Numerical Analysis.
2. Dutta and Jana- Numerical Analysis.
3. S. A. Mollah- Numerical Analysis and Computational Procedures
4. J. K. Goyal, K. P. Gupta, G. S. Gupta - Laplace's and Fourier Transforms
5. Sreenadh S. et. al. - Fourier series and Integral Transforms
6. A.N. Srivastava - Integral Transforms and Fourier Series

CO-PO-PSO MAPPING:

CO/PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	2	-	-	-	-	-	-	1	3	2	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2	3	3	2
CO3	2	3	3	2	3	-	-	-	-	-	-	1	3	3	2
CO4	3	3	3	3	3	1	2	-	-	-	-	2	3	3	2
CO5	3	3	3	3	3	1	2	1	-	-	-	2	3	3	2
CO6	3	3	3	2	2	1	-	-	-	-	-	1	3	3	2
	2.8	2.8	2.7	2.4	2.7	1.0	2.0	1.0	-	-	-	1.5	3.0	2.8	1.8

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem

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Course Title: Environmental Science (EVS)	**Subject Code:** TIU-UMB-T201
Contact Hours/Week: 2-0-0 (L-T-P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Understand the fundamentals of environmental pollution from chemical processes, including characterization of emissions and effluents, and relevant environmental regulations.
2. Apply pollution prevention strategies through process modification, resource recovery, and waste minimization techniques.
3. Analyse and design air and water pollution control systems, including particulate and gaseous emission control, and physical water treatment processes.
4. Evaluate and implement biological treatment methods for wastewater and appropriate solid waste disposal techniques.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Describe the sources and types of environmental pollution from chemical process industries, characterize industrial emissions and effluents, Explain relevant environmental laws, rules, and standards.	K2
CO-2:	Apply process modification and alternative raw material selection for pollution prevention, develop strategies for recovery, recycle, and reuse of industrial waste, perform material and energy balance calculations for pollution minimization, Implement water use minimization and fugitive emission/effluent control measures.	K3
CO-3:	Select and design appropriate particulate emission control systems (cyclones, ESP, fabric filters), Select and design gaseous emission control systems (absorbers), Analyse the performance of air pollution control equipment.	K4
CO-4:	Explain the principles of physical and pre-treatment methods for wastewater, Design and evaluate solids removal processes (sedimentation, filtration, centrifugation, coagulation, flocculation).	K5
CO-5:	Describe the principles of anaerobic and aerobic biological treatment, apply biochemical kinetics to design biological treatment systems, Select and design aeration systems and sludge separation/drying processes.	K6
CO-6:	Evaluate different solid waste disposal methods (composting, landfill, incineration), Explain the processes of briquetting and gasification of solid waste.	K5

COURSE CONTENT:

MODULE 1:	**Introduction**	**10 Hours**
Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents.		
MODULE 2:	**Pollution Prevention**	**8 Hours**

Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.		
MODULE 3:	**Air Pollution Control**	**9 Hours**
Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers		
MODULE 4:	**Water Pollution Control**	**9 Hours**
Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation		
MODULE 5:	**Biological Treatment**	**5 Hours**
Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying		
MODULE 6:	**Solid Disposal**	**4 Hours**
Solids waste disposal - composting, landfill, briquetting / gasification and incineration.		
TOTAL LECTURES		**45 Hours**

Books:

1. A. K. De, “Environmental Chemistry”, New Age
2. G. M. Masters, “Introduction to Environmental Engineering and Science”, Pearson
3. G. S. Sodhi, “Fundamental Concepts of Environmental Chemistry”, Narosa
4. E. Odum, M. Barrick& G. W. Barrett, “Fundamentals of Ecology”, Brooks

CO-PO-PSO MAPPING:

CO/PO-PSO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	–	–	–	3	3	3	–	–	–	2	1	–	–
CO2	3	3	3	2	2	2	3	–	–	–	–	2	2	2	2
CO3	3	3	3	2	2	2	3	–	–	–	–	2	2	2	2
CO4	3	3	3	3	2	–	–	–	–	–	–	2	1	2	2
CO5	3	3	3	3	2	–	2	–	–	–	–	2	2	2	2

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CO6	3	3	2	2	2	3	3	2	–	–	–	2	2	2	2
	3.0	2.8	2.8	2.4	2.0	2.5	2.8	2.5	-	-	-	2.0	1.7	2.0	2.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem
Course Title: Analog Electronics Lab	**Subject Code:** TIU-UEE-L207
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. To familiarize students with core concepts such as voltage, current, resistance, capacitance, inductance, frequency in analog circuits and train students to use laboratory instruments like oscilloscopes, multimeters, signal generators, and power supplies for circuit analysis.
2. To Enable students to design, construct, and test analog electronic circuits like amplifiers, oscillators, filters, and rectifiers.
3. To Introduce students to circuit simulation software (e.g., SPICE) for designing and testing analog circuits before building them physically.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Simulate analog circuits and predict their performance before physical implementation.	K3
CO-2	To analyse the operation and characteristics of Halfwave and Full wave rectifier circuit.	K4
CO-3	To analyse the operation and characteristics of BJT.	K4
CO-4	To analyse the operation and characteristics of MOSFET and JFET.	K2
CO-5	To understand the functioning of OP-AMP and design of OP-AMP based low pass, high pass, band pass and band stop filter.	K3
CO-6	To design and analyse RC phase shift oscillator circuit.	K4

COURSE CONTENT:

MODULE 1:	Diode Applications	**9 Hours**
Study the characteristics of a PN Junction Diode. Applications of diodes in Rectifiers.		
MODULE 2:	Transistor Characteristics and Biasing	**12 Hours**
Input and Output Characteristics of BJT in CB, CE, and CC Configurations.		

Biasing techniques of BJT.		
MODULE 3:	Amplifiers	**9 Hours**
Design and analysis of single-stage and multi-stage amplifiers. Frequency response of amplifiers.		
MODULE 4:	Oscillators	**12 Hours**
Design and analysis of RC Phase Shift Oscillator, Colpitts Oscillator. Stability and frequency of oscillators.		
TOTAL LAB HOURS		**42 Hours**

Books:

1. Laboratory Manuals
2. Electronic Devices and Circuit Theory: Boylestad
3. Electronic Principles: Malvino and Bates

CO-PO-PSO MAPPING:

CO/PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	3	–	–	–	–	–	–	2	2	3	3
CO2	3	3	3	2	2	–	–	–	–	–	–	2	2	3	3
CO3	3	3	3	2	2	–	–	–	–	–	–	2	2	3	3
CO4	3	2	2	–	2	–	–	–	–	–	–	2	2	2	2
CO5	3	3	3	2	3	–	–	–	–	–	–	2	2	3	3
CO6	3	3	3	2	3	–	–	–	–	–	–	2	2	3	3
	3.0	2.8	2.8	2.0	2.5	-	-	-	-	-	-	2.0	2.0	2.8	2.8

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Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem
Course Title: Electrical Circuit Theory Lab	**Subject Code:** TIU-UEE-L209
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. To familiarize students with various passive and active components such as resistors, capacitors, inductors and learn how to measure and analyze electrical parameters such as voltage, current, power and frequency using instruments such as oscilloscopes, multimeters, and function generators.
2. To help students apply basic electrical laws (Ohm's Law, Kirchhoff's Voltage and Current Laws) in real-world circuits and understand their practical implications.
3. To use circuit simulation tools such as SPICE to model and analyze circuit behavior before building physical circuits.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Analyse the DC and AC circuits using Mesh and Nodal analysis and network simplification Theorems.	K4
CO-2	Analyse the DC transients in R-L, R-C and R-L-C circuits.	K4
CO-3	Analyse any two-port network and representation using different parameters.	K4
CO-4	Understand and analyse frequency response of series RLC circuits.	K4
CO-5	Analyse and measure the behaviour of DC and AC circuits and the impact of resistive, capacitive, and inductive components on the circuit's performance.	K4
CO-6	Apply the concepts of time-domain and frequency-domain analysis to analyse the behaviour of circuits under different conditions.	K4

COURSE CONTENT:

MODULE 1:	Network Theorems	**12 Hours**
Verification of Thevenin's Theorem, Verification of Norton's Theorem, Verification of Superposition Theorem.		

MODULE 2:	AC Circuit Analysis	**9 Hours**
Measurement of power in a three-phase circuit using the two-wattmeter method, Study of RLC series circuit and calculation of impedance and power factor.		
MODULE 3:	Resonance	**9 Hours**
Study of series resonance in RLC circuits, Study of parallel resonance in RLC circuits.		
MODULE 4:	Transient Response	**12 Hours**
Study of transient response of RC, RL, and RLC circuits to DC excitation, Observation and plotting of current and voltage waveforms.		
TOTAL LAB HOURS		**42 Hours**

Books:

1. Laboratory Manuals
2. Network Analysis: M.E.Van Valkenburg, PHI
3. Network Analysis and Synthesis: Bhattacharya and Singh, Pearson

CO-PO-PSO MAPPING:

CO/PO-PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
CO2	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
CO3	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
CO4	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
CO5	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
CO6	3	3	2	2	2	–	–	–	–	–	–	2	2	2	2
	3.0	3.0	2.0	2.0	2.0	-	-	-	-	-	-	2.0	2.0	2.0	2.0

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Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem
Course Title: Mathematics –III Lab (Numerical Methods)	**Subject Code:** TIU-UMA-L203
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the mathematical foundations of various numerical methods and their significance in solving engineering and scientific problems.
2. Apply numerical techniques to solve algebraic equations, system equations, interpolation, differentiation, and integration using computational tools.
3. Analyse the accuracy, stability, and applicability of numerical methods while implementing them for real-world engineering applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Approximate a function by a linear polynomial	K4
CO-2	Calculate the approximate the area under a curve	K4
CO-3	Use numerical techniques to find the approximate solution of algebraic and transcendental equations	K4
CO-4	Find the exact solution of a system of equations by direct methods	K4
CO-5	Find the approximate solution of a system of equations by indirect methods	K4
CO-6	Find the numerical solution for initial value problems (IVPs)	K4

COURSE CONTENT:

MODULE 1:	**FORWARD AND BACKWARD DIFFERENCE TABLE**	**9 Hours**
Introduction to finite differences and their applications, Forward and Backward Difference Operators, Construction of Difference Tables, Higher-order differences and accuracy analysis		
MODULE 2:	**INTERPOLATION METHODS**	**9 Hours**

Newton's Forward and Backward Interpolation Formulas, Lagrange's Interpolation Method, Applications of interpolation in numerical computations		
MODULE 3:	**NUMERICAL INTEGRATION**	**6 Hours**
Introduction to Numerical Integration, Trapezoidal Rule and its implementation, Simpson's 1/3rd Rule and applications, Error analysis in numerical integration		
MODULE 4:	**NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS**	**6 Hours**
Bisection Method: Concept, Algorithm, and Implementation, Newton-Raphson Method: Convergence, Limitations, and Applications		
MODULE 5:	**NUMERICAL SOLUTION OF A SYSTEM OF EQUATIONS**	**6 Hours**
Introduction to solving systems of linear equations, Gauss Elimination Method: Direct approach to solving equations, Gauss-Seidel Iterative Method: Convergence and Stopping Criteria		
MODULE 6:	**NUMERICAL SOLUTION OF INITIAL VALUE PROBLEMS**	**9 Hours**
Euler's Method: Concept and Implementation, Modified Euler's Method for higher accuracy, Runge-Kutta Methods: 2nd and 4th Order Techniques, Applications in solving Ordinary Differential Equations (ODEs).		
TOTAL LAB HOURS		**45 Hours**

Books:

1. Balagurusamy, E. (2017). Numerical Methods (1st ed.). McGraw-Hill Education.
2. Veerarajan, T., & Ramachandran, T. (2006). Numerical Methods with Programs in C and C++ (1st ed.). Tata McGraw-Hill.
3. Chapra, S. C. (2018). Applied Numerical Methods with MATLAB for Engineers and Scientists (4th ed.). McGraw-Hill Education.
4. Pradeep, N., & Govindarajan, G. (2008). Numerical Methods and Computer Programming (1st ed.). New Age International Publishers.
5. Grewal, B. S. (2019). Numerical Methods in Engineering and Science with Programs in C and C++ (10th ed.). Khanna Publishers.
6. Rajaraman, V. (2012). Computer Oriented Numerical Methods (3rd ed.). PHI Learning Pvt. Ltd.

CO-PO-PSO MAPPING:

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

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	2.8	2.8	2.7	2.4	2.7	1.0	2.0	1.0	-	-	-	1.5	3.0	2.8	1.8

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 3rd Sem
Course Title: CASD: Fundamentals of AUTOCAD	**Subject Code:** TIU-UEE-S297A
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. To introduce students to AutoCAD and its essential tools for design, drafting etc.
2. To develop proficiency in using drafting settings, drawing, and modification tools to create precise 2D sketches.
3. To enable students to design electrical layouts and residential floor plans using AutoCAD software.
4. To enhance students' ability to create and modify drawings using industry-standard practices.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Demonstrate an understanding of AutoCAD fundamentals and user interface.	K2
CO-2	Develop 2D sketches of electrical components and layouts using AutoCAD.	K3
CO-3	Design and implement electrical wiring layouts for residential and industrial applications.	K4
CO-4	Create electrical symbols, motor control circuits, and substation single-line diagrams using AutoCAD.	K4
CO-5	Apply drawing and editing commands to create simple electrical schematics and control circuits.	K3
CO-6	Develop and interpret electrical ladder diagrams, panel layouts, and wiring diagrams using AutoCAD Electrical tools.	K6

COURSE CONTENT:

Module 1:	**Introduction to AutoCAD**	**6 Hours**
Overview of AutoCAD software and its applications-Understanding the workspace, command line, toolbars, and navigation tools-Introduction to coordinate systems (absolute, relative, and polar)-Basic drawing commands such as LINE, CIRCLE, ARC, and RECTANGLE.		
Module 2:	**Familiarization with Drafting Settings and Drawing with AutoCAD**	**6 Hours**

	Tools	
Understanding grid, snap, and object snap (OSNAP) settings-Use of Ortho mode, Polar tracking, and Dynamic Input for precise drafting-Working with layers, line types, and colours for better drawing organization-Hands-on practice using fundamental drawing commands like POLYLINE, SPLINE, ELLIPSE, and TEXT.		
Module 3:	**Familiarization with Various types of Drawing Tools and Modify Tools**	**6 Hours**
Introduction to object selection methods-Using modify commands such as MOVE, COPY, ROTATE, MIRROR, TRIM, EXTEND, OFFSET, and SCALE-Introduction to ARRAY commands (Rectangular, Polar, Path)-Use of BLOCK and EXPLODE for reusable design elements-Hands-on practice in editing and modifying drawings efficiently.		
Module 4:	**2D SKETCH OF PRACTICE MODEL**	**6 Hours**
Developing a detailed 2D representation of a given practice model-Application of dimensioning and annotation tools for technical documentation-Use of hatch patterns to represent different materials.		
Module 5:	**Design a flat using commercially available AutoCAD software**	**6 Hours**
Creating a scaled floor plan with walls, doors, and windows-Annotation and dimensioning for professional presentation.		
Module 6:	**2D SKETCH OF PRACTICE MODEL**	**6 Hours**
Working on a complex practice model with multiple geometric elements-Applying advanced editing tools for precision modifications-Finalizing the drawing with proper scaling and plotting settings.		
TOTAL LAB HOURS:		**36 Hours**

Books:

1. Laboratory Manuals

2. Handbook of Electrical Design, Neil Sclater, John E. Traister

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO2	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO3	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO4	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO5	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO6	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
	-	-	-	-	-	-	-	-	2.0	3.0	-	-	-	-	-

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 3rd Sem
Course Title: CASD: Foreign Language: French	**Subject Code:** TIU-UEN-S297B
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. Acquire basic communication skills in French.
2. Develop listening, speaking, reading, and writing abilities at a beginner level.
3. Understand and use simple grammatical structures and everyday vocabulary.
4. Engage in basic conversations in French related to common situations.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Recognise and use common French greetings and expressions.	K1
CO-2:	Memorise and repeat simple sentences using regular verbs and basic vocabulary.	K1
CO-3:	Understand and respond to basic questions about personal identity.	K2
CO-4:	Identify and explain short passages related to daily life.	K2
CO-5:	Construct short texts such as self-introductions and informal messages.	K3
CO-6:	Arrange isolated sentences and questions to engage in simple spoken exchanges in a variety of familiar contexts.	K4

COURSE CONTENT:

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MODULE 1:	INTRODUCTION TO FRENCH LANGUAGE ● The French alphabet and pronunciation ● Greetings and introductions ● Numbers and basic expressions of time	**6 Hours**
MODULE 2:	IDENTITY AND PERSONAL INFORMATION ● Talking about oneself and others ● Nationalities, professions, and family ● Using "être" and "avoir" verbs	**6 Hours**
MODULE 3:	EVERYDAY INTERACTIONS ● Asking for and giving personal details ● Talking about preferences and habits ● Introduction to regular -ER verbs	**6 Hours**
MODULE 4:	● Ordering at a café or restaurant ● Asking for directions ● Using "aller" and "faire" verbs	**6 Hours**
MODULE 5:	DESCRIBING DAILY LIFE ● Talking about routines and leisure activities ● Expressing likes and dislikes ● Introduction to present tense conjugation	**6 Hours**
TOTAL LECTURES		**30 Hours**

Books:

Tech French - French for Science and Technology, Goyal Publishers, 2011

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PSO 1	PSO 2	PSO 3

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CO1	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO2	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO3	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO4	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO5	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO6	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
	-	-	-	-	-	-	-	-	2.0	3.0	-	-	-	-	-

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SEMESTER 4

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Electrical Machines-I	**Subject Code:** TIU-UEE-T202
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for calculation of electric field in various situation.
2. To enable the student to the theoretical basis for calculation of magnetic field in various situation.
3. To enable the student to understand the propagation of electromagnetic wave.
4. To develop the theoretical concepts of electromechanical devices used in industry

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	define the fundamentals, laws, magnetic circuits and flux distribution, electromagnetic force production and DC & AC machines	K1
CO-2:	Detailed construction and operating principle, Materials used for D.C. machines, different types and effect of DC generator, losses, Voltage build up, efficiency, speed	K2

	control of DC generator.	
CO-3:	Characteristics and applications of different types of DC motors, methods of starting, speed control, Series parallel operation of motors. Different types of DC motor starters. Testing of DC motors.	K3
CO-4:	Construction and basic principle of operation of 1-phase transformer, types of 1-phase transformer, materials for cores, winding and insulation. EMF equation. Losses and Leakage reactance, Harmonics, electrical equivalent circuit from magnetic structure	K3
CO-5:	To know the various tests of Transformer, phasor diagram, Auto transformer, all day efficiency, regulation, equivalent circuit parameters and parameter shifting, cooling, different types of connection for three phase transformer, vector group, parallel operation, Scott connection, open delta, harmonics.	K4
CO-6:	Tank and radiator, Transformer oil& accessories, Power and Distribution Transformers.	K3

COURSE CONTENT:

MODULE 1:	**General introduction to electrical machines**	**6 Hours**
Faraday's laws of electromagnetic induction, Fleming's rule and Lenz's Law. Principle of operation of generators and motors. Space distribution of flux density and time variation of voltage. Flux wave in dc and ac machines. Magnetic curves and their relevance.		
MODULE 2:	**DC Machines**	**6 Hours**
Detailed construction and operating principle. Materials used for D.C. machines. Function of Commutator and brush system. Induced emf in dc machine. Separate, Shunt, Series and Compound excitation. Losses and efficiency. Voltages buildup of dc shunt generator. DC motoring action. Torque developed in dc motor. Armature windings, Equalizers. Armature reaction & its effects, mmf distribution, compensating windings, Interpoles, Laminated yoke construction. Commutation, sparking, brushes, interface film. DC Generators Characteristics with different excitation systems, voltage regulation, parallel operation.		
MODULE 3:	**DC Motors**	**6 Hours**
DC Motors – Characteristics and applications of Separate, Shunt, Series and Compound motors, methods of starting, speed control, equivalent circuit. Series parallel operation of motors, necessity of starter, different types of DC motor starter. Testing of dc machines (Swinburne test, Hopkinson's test, Brake test. Tests specified as per standards).		
MODULE 4:	**Single Phase Transformer**	**6 Hours**
1-phase Transformers: Construction and basic principle of operation. Core type and shell type. Materials used for core, winding and insulation. EMF equation. Core loss, copper loss and Leakage reactance. Harmonics in magnetizing current and magnetizing in-rush current. Generalized derivation of electrical equivalent circuit from magnetic structure. Equivalent circuit referred to primary. Phasor diagram. Parallel operation. Effects of changes of frequency and voltage on transformer performance.		
MODULE 5:	**Test and other parameters**	**6 Hours**
all-day efficiency. Testing of transformers: Polarity of windings, OC and SC test, separation of losses, determination of equivalent circuit parameters. Regulation, efficiency, Single phase auto-transformers, principle of operation, phasor diagram. Comparison of weight, copper loss equivalent reactance with 2 winding transformers.		
MODULE 6:	**Different Types of transformer Accessories**	**6 Hours**

Dry-type and oil cooled type. Natural and forced types of cooling. Tank and radiator construction, operation. Transformer oil. Transformer accessories, e.g., conservator, breather, Bucholtz relay, bushing, etc. Power and Distribution Transformers, 3-phase Transformers: As a single unit with name plate rating and as a bank of three single phase Transformers; Vector groups for various connections; per phase analysis; Qualitative explanation for origin of harmonic current and voltage and its suppression tertiary winding. Parallel operation conditions and load sharing. Autotransformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformers.		
MODULE 7:	**3-phase Transformers**	**6 Hours**
3-phase Transformers: As a single unit with name plate rating and as a bank of three single phase Transformers; Vector groups for various connections; per phase analysis; Qualitative explanation for origin of harmonic current and voltage and its suppression tertiary winding. Parallel operation conditions and load sharing. Autotransformer: Basic constructional features; VA conducted magnetically and electrically. Comparative study with two winding transformers.		
TOTAL LECTURES		**42 Hours**

Books:

1. Performance and Design of Alternating Current Machines: M.G. Say CBS Publishers & Distributors, SBN: 9788123910277
2. Performance and Design of DC machines: Clayton & Hancock. CBS Publishers &Distributors
3. Electrical Machinery: P. S. Bimbhra Khanna Publishers, ISBN 978-8174091734
4. Electric Machines: I. J. Nagrath& D. P. Kothari McGraw Hill Education, isbn978-9352606405
5. Electrical Machines: A Hussain Dhanpatrai & Co, ISBN 9788177001662

CO-PO-PSO MAPPING:

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

	2.8	2.5	2.3	-	-	-	-	-	-	-	-	-	2.0	2.8	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Electrical Measurement & Measuring Instruments	**Subject Code:** TIU-UEE-T204
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for analog meters.
2. To enable the student to the theoretical basis for measurement of Current, Resistance, Power and Energy.
3. To enable the student to understand electronic instruments
4. To develop the theoretical concepts of AC Bridges

COURSE OUTCOME:

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On completion of the course, the student will be able to:

CO-1:	To understand the basics of measurement and analog instruments	K2
CO-2:	To apply the knowledge of magnetic field in instrument transformer	K3
CO-3:	To apply the knowledge of basic electrical engineering in measurement of Resistance, Power and Energy.	K4
CO-4:	To understand the principles of AC bridges.	K2
CO-5:	To understand digital instruments	K2
CO-6:	To understand the working principles of oscilloscope and use of oscilloscope	K2

COURSE CONTENT:

MODULE 1:	**Basics of Measurement**	**4 Hours**
Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments.		
MODULE 2:	**Analog meters**	**6 Hours**
General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamometer, Induction instruments, Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers. Response of 2nd order system		
MODULE 3:	**Instrument transformer**	**6 Hours**
Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Principle of operation of Current & Potential transformer.		
MODULE 4:	**Measurement of Resistance**	**4 Hours**
Measurement of medium, low and high resistances, Megger		
MODULE 5:	**Measurement of Power and Energy**	**4 Hours**
Principle of operation of Electrodynamic & Induction type wattmeter. Wattmeter errors, Construction, theory and application of AC energy meter, testing of energy meters.		
MODULE 6:	**AC bridges**	**6 Hours**
Measurement of Inductance, Capacitance and frequency by AC bridges. Q meter		
MODULE7:	**Cathode Ray Oscilloscope**	**6 Hours**
Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO.		
MODULE8:	**Electronic Instruments**	**6 Hours**
Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator.		

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TOTAL LECTURES	**42 Hours**

Books:

1. Electrical and electronic measurement by Prithwiraj Purkait.
2. A course in electrical and electronic measurement by A K Sawhney.
3. Electrical measurement and Measuring Instruments by Golding

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	–	–	2	2	–
CO2	3	3	2	–	–	–	–	–	–	–	–	–	–	3	2
CO3	3	3	3	–	–	–	–	–	–	–	–	–	–	3	3
CO4	3	2	–	–	–	–	–	–	–	–	–	–	–	2	–
CO5	2	2	–	–	–	–	–	–	–	–	–	–	–	2	–
CO6	2	2	–	–	–	–	–	–	–	–	–	–	–	2	–
	2.7	2.3	2.5	-	-	-	-	-	-	-	-	-	2.0	2.3	2.5

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 4th Sem
Course Title: Signals & Systems	**Subject Code:** TIU-UEE-T208
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. At the end of this course, students will demonstrate the ability to understand the concepts of continuous time and discrete time systems.
2. Analyse systems in complex frequency domain.
3. Understand sampling theorem and its implications.

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COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Explain the fundamental concepts of signals and systems, including their properties and classifications.	K2
CO-2:	Analyse the behaviour of continuous and discrete-time LTI systems using convolution, impulse response, and state-space representation.	K4
CO-3:	Apply Fourier, Laplace, and z-transforms to analyse signals and systems in the frequency and time domains.	K3
CO-4:	Evaluate the stability, causality, and realizability of systems using mathematical representations.	K5
CO-5:	Demonstrate the process of sampling and reconstruction and assess its impact on signal processing applications.	K3
CO-6:	Design signal processing techniques for real-world applications such as communication, filtering, and control systems.	K6

COURSE CONTENT:

MODULE 1:	**Introduction to Signals and Systems**	**8 Hours**
Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.		
MODULE 2:	**Behavior of continuous and discrete-time LTI systems**	**12 Hours**
Impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.		
MODULE 3:	**Fourier, Laplace and z- Transforms**	**14 Hours**
Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behaviour. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.		
MODULE 4:	**Sampling and Reconstruction**	**6 Hours**

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The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

TOTAL LECTURES	**40 Hours**

Books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, "Signals and systems", Prentice Hall India
2. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons
3. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	–	–	2	2	–
CO2	3	3	2	–	–	–	–	–	–	–	–	–	–	3	2
CO3	3	3	2	–	–	–	–	–	–	–	–	–	–	3	2
CO4	3	3	2	–	–	–	–	–	–	–	–	–	–	2	–
CO5	3	2	–	–	–	–	–	–	–	–	–	–	–	2	–
CO6	3	3	3	–	2	–	–	–	–	–	–	–	–	3	2
	3.0	2.7	2.3	-	2.0	-	-	-	-	-	-	-	2.0	2.5	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 4th Sem
Course Title: Digital Electronics Circuits	**Subject Code:** TIU-UEE-T214
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. to introduce the fundamental concepts of digital logic and circuit design.
2. understand and apply Boolean algebra to digital circuit design.
3. identify and analyze different types of logic gates and combinational circuits.
4. design and implement sequential circuits such as flip-flops, counters, and registers.

5. apply digital circuit design principles to solve real-world problems.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Convert several number and coding systems used in digital communication and computer systems.	K2
CO-2:	Utilize the coding and numbering systems and compare several logic families, the fundamental building blocks of various logic gates, in terms of cost, effectiveness, and efficiency.	K3
CO-3:	Analyse various digital electronic circuit types using various mapping and logical tools, and be familiar with the procedures for creating the most basic circuit possible using various mapping and mathematical techniques.	K4
CO-4:	For a given operation, create many forms of digital electrical circuits with and without memory elements while keeping in mind the limitations of cost, performance, efficiency, usability, and the environment.	K3
CO-5:	Apply the fundamental understanding of analog and digital electronics to produce various analog to digitalized signals and vice versa converters in the actual world under various varying conditions.	K2
CO-6:	Analyse the terminology and technology in the domain of memory devices and integrate them into various digital circuit types for use in real-world applications.	K3

COURSE CONTENT:

MODULE 1:	**Fundamentals of Digital Systems and logic families**	**6 Hours**
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.		
MODULE 2:	**Combinational Digital Circuits**	**8 Hours**
Standard representation for logic functions, K-map representation, simplification of Logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/ generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.		
MODULE 3:	**Sequential circuits and systems**	**8 Hours**
A 1-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, J- K-T And D types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.		
MODULE 4:	**A/D and D/A Converters**	**8 Hours**
Digital to analog converters: weighted resistor/ converter, R-2R Ladder D/A converter specifications for		

D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage of frequency and voltage to time conversion, specifications of A/D converter example of A/D converter ICs.		
MODULE 5:	**Semiconductor memories and Programmable logic devices**	**10 Hours**
Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).		
TOTAL LECTURES		**40 Hours**

Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. Arivazhagan S and S. Salivahanan, “Digital Circuits and Design”, Oxford University Press, 2018
3. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
4. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2	3	2	2	–	2	–	–	–	–	–	–	–	–	3	2
CO3	3	3	3	–	2	–	–	–	–	–	–	–	–	3	2
CO4	3	2	3	–	2	2	2	–	–	–	–	–	–	3	2
CO5	2	2	2	–	3	–	–	–	–	–	–	–	–	3	2
CO6	3	2	3	–	2	–	–	–	–	–	–	–	–	3	2
	2.8	2.2	2.6	-	2.2	2.0	2.0	-	-	-	-	-	2.0	3.0	2.8

CO-PO-PSO MAPPING:

Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 4th Sem
Course Title: Probability and Statistics	**Subject Code:** TIU-UMA-T202
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit:** 3

Department of Electrical Engineering

COURSE OBJECTIVE:

Enable the student to:

1. understand the basics of probability and statistical analysis
2. analyze the nature of problems solved with probability distribution
3. understand basic statistics, dispersion, regression and curve fitting technique

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To illustrate the foundations of probabilistic and statistical analysis mostly used in varied applications	K4
CO-2:	To investigate the probability using basic knowledge and fundamental concepts of probability.	K4
CO-3:	To formulate and analyse several well-known distributions, including Binomial, Poisson, Normal, Exponential Distributions etc., and understand their scope of application to real world problems	K4
CO-4:	To establish the basic statistical concepts and measures of central tendencies	K4
CO-5:	To calculate Measures of dispersion – standard deviation, variance	K4
CO-6:	To analyse observations in terms of regression and curve fitting	K4

COURSE CONTENT:

MODULE 1:	**PROBABILITY**	**25 Hours**
Probability: Classical, relative frequency and axiomatic definitions of probability, mutually exclusive events, independent events, conditional probability, Bayes' Theorem. Random Variables: Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments. Distributions: Uniform, Binomial, Geometric, Poisson, Negative binomial, Exponential, Normal distributions, Joint and marginal distribution.		
MODULE 2:	**STATISTICS**	**20 Hours**
Graphical representation of data, Frequency distributions, Measures of central tendencies – mean, median, mode, Measures of dispersion – standard deviation, variance, Principle of Least Squares, curve fitting, regression analysis.		
TOTAL LECTURES		**45 Hours**

Books:

1. Ravish R Singh, Mukul Bhatt Engineering Mathematics, McGraw-Hill Education
2. N G Das, Statistical Methods, McGraw-Hill
3. Sheldon M. Ross, Introduction to Probability band Statistics for Engineers and Scientists, McGraw-Hill.

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2	3	3	–	–	–	–	–	–	–	–	–	–	2	–	–
CO3	3	3	2	–	–	–	–	–	–	–	–	–	2	–	–
CO4	3	2	–	–	–	–	–	–	–	–	–	–	2	–	–
CO5	3	2	–	–	–	–	–	–	–	–	–	–	2	–	–
CO6	3	3	2	–	–	–	–	–	–	–	–	–	2	–	–
	3.0	2.5	2.0	-	-	-	-	-	-	-	-	-	2.0	-	-

CO-PO-PSO MAPPING:

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Electrical Machines Lab-I	**Subject Code:** TIU-UEE-L208
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. To familiarize students with more conversant about the underlying energy conversion theory between electrical and mechanical systems by introducing electromechanical energy conversion principles.
2. To expose the students to the concepts of various types of electrical machines and applications of electrical machines.
3. To develop the ability to diagnose faults and perform maintenance on electrical or mechanical machines.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the basic principles of DC machines and transformers.	K1
CO-2:	Explain the working and construction of DC machines and transformers.	K2
CO-3:	Perform and analyse various tests on electrical machines to determine their characteristics.	K3
CO-4:	Evaluate performance parameters and efficiency of DC machines.	K4
CO-5:	Evaluate performance parameters and efficiency of transformers.	K4
CO-6:	Understand working principle and analyse operation of single-phase transformers & DC machine.	K3

COURSE CONTENT:

Module 1	**D.C generator**	**12 Hours**
Basic working principle of a D.C. generator, types of D.C. generators: Series, Shunt, and Compound, applications of D.C. shunt generators, Definition of No-Load Characteristics (O.C.C.), Importance of O.C.C. in generator performance analysis, Relationship between generated EMF and field current.		
Module 2	**D.C. Motor**	**15 Hours**
D.C motor is connected to its rated supply at rest position, it draws high current which is more than rated current. This current may cause damage to the armature windings. So, at the time of starting of D.C motor either a suitable series rheostat in series with armature or a 3-Point starter is used. For Reversing speed of the motor only changed either shunt field terminal or armature coil terminal. Basic working principle of a		

D.C. motor, Construction and operation of a D.C. shunt motor, Importance of speed control in industrial applications - EMF equation of a D.C. motor, Speed equation: Factors affecting speed, Armature voltage, Field flux, Armature resistance.		
Module 3	**Single-Phase Transformer (Open Circuit)**	**15 Hours**
Basic working principle of a transformer, Construction and operation of a single-phase transformer, Importance of efficiency and loss analysis - Transformer EMF equation, Concept of **iron losses** (hysteresis and eddy current losses)- Equivalent circuit representation under no-load conditions. Basic working principle of a transformer, Construction and components of a single-phase transformer, Importance of efficiency and loss analysis - Copper loss.		
TOTAL LAB HOURS:		**42 Hours**

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–
CO2	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–
CO3	3	2	2	–	–	–	–	–	–	–	–	–	2	2	–
CO4	3	2	2	–	–	–	–	–	–	–	–	–	2	2	–
CO5	3	2	2	–	–	–	–	–	–	–	–	–	2	2	–
CO6	3	2	2	–	–	–	–	–	–	–	–	–	2	2	–
	2.7	2.0	2.0	-	-	-	-	-	-	-	-	-	1.7	2.0	-

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Electrical Measurement & Measuring Instruments Lab	**Subject Code:** TIU-UEE-L210
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. To introduce students to different electrical measurement techniques using various instruments.
2. To develop an understanding of measuring resistance, power, strain, inductance, and sensor-based parameters.
3. To enable students to analyse and interpret experimental data for practical applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Understand the principles and applications of strain measurement using strain gauges.	K2
CO-2	Apply the voltmeter-ammeter method for medium resistance measurement.	K3
CO-3	Analyse power measurement in three-phase circuits using the two-wattmeter method.	K4
CO-4	Understand and implement the Kelvin double bridge method for low resistance measurement.	K2
CO-5	Explain the operation and applications of displacement and temperature sensors (LVDT, RTD, Thermocouples).	K3
CO-6	Measurement of unknown inductance and losses using Maxwell's Inductance bridge.	K4

COURSE CONTENT:

MODULE 1:	Measurement of Resistance and Strain	**12 Hours**
Understand Measurement principles, accuracy, precision- Measurement of strain using strain gauge, Gauge Factor-Measurement of Medium and Low Resistance-Loading effect- Various practical applications.		
MODULE 2:	Power and Loss Measurement	**9 Hours**
Explanation of the two-wattmeter method for measuring three-phase power- Power Equations- Phase Angle and Power Factor Calculation- Explanation of hysteresis and eddy current losses in magnetic materials- Understanding the B-H curve, factors affecting hysteresis loss- Eddy Current Loss- Applications		
MODULE 3:	Sensors and Transducers	**9 Hours**

Understanding the working of LVDT- Construction and working mechanism and its performance-Principle of Temperature Measurement- Types of Temperature Sensors, error sources, and compensation methods-Various practical Applications		
MODULE 4:	AC Bridge and Inductance Measurement	**12 Hours**
Understand the operation of AC bridges-Mathematical formulation to determine the unknown self-inductance by balancing bridge-Operation of Maxwell's Bridge-Phase Angle Consideration-Applications		
TOTAL LAB HOURS		**42 Hours**

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–
CO2	3	–	–	–	–	–	–	–	–	–	–	–	1	2	–
CO3	3	–	2	–	–	–	–	–	–	–	–	–	–	2	–
CO4	2	–	–	–	–	–	–	–	–	–	–	–	1	–	–
CO5	3	–	–	–	–	–	–	–	–	–	–	–	–	2	1
CO6	3	–	2	–	–	–	–	–	–	–	–	–	–	2	–
	2.7	-	2.0	-	-	-	-	-	-	-	-	-	1.0	2.0	1.0

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: Digital Electronics Circuits Lab	**Subject Code:** TIU-UEE-L214
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit:** 1

COURSE OBJECTIVE:

Enable the student to:

1. Familiarize students with basic digital logic gates and Boolean algebra to develop a strong foundation in digital electronics.
2. Enable students to design, simulate, and implement combinational and sequential circuits using logic gates and digital ICs.
3. Provide hands-on experience in constructing and testing digital circuits such as multiplexers, decoders, adders, flip-flops, and counters.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Design and implement basic logic gates and combinational circuits using digital ICs.	K3
CO-2	Analyse and verify the functionality of sequential circuits, including flip-flops, registers, and counters.	K4
CO-3	Demonstrate the working of arithmetic and logic circuits such as adders, subtractors, and multiplexers.	K2
CO-4	Develop and test simple digital systems using hardware components and simulation tools.	K4
CO-5	Interpret and troubleshoot digital circuits based on truth tables, timing diagrams, and Boolean expressions.	K4
CO-6	Apply digital logic principles in real-time electrical and electronics applications.	K3

COURSE CONTENT:

MODULE 1:	**Logic Gates & Boolean Algebra**	**8 Hours**
Understand and verification of the fundamental logic gates (AND, OR, NOT, NAND, NOR, XOR, and XNOR) and their truth tables using digital ICs-Understand the concept of universal gates (NAND and NOR) and their significance in digital circuit design - Realize basic logic gates (AND, OR, NOT, XOR, XNOR) using only NAND and NOR gates and verify their functionality		
MODULE 2:	**Number Systems & Code Conversions**	**6 Hours**
To understand the significance of Gray code and Binary code in digital systems - To design and implement Gray-to-Binary and Binary-to-Gray code converters using logic gates - To learn the		

fundamentals of Binary-Coded Decimal (BCD) and Excess-3 codes - To design and implement circuits for BCD-to-Excess-3 and Excess-3-to-BCD conversion.		
MODULE 3:	**Arithmetic Circuits**	**6 Hours**
Understand the fundamental principles of arithmetic circuits half adder, full adder and half subtractor, full subtractor -Design and implementation of half adder, full adder circuit and half subtractor, full subtractor circuit - Application.		
MODULE 4:	**Combinational Logic Design**	**10 Hours**
Understand the fundamental principles of encoders, decoders and multiplexer (MUX) and their role in digital circuit design - Analyze the working of standard encoders and decoders-Design and implement an 8×1 multiplexer using logic gates and digital ICs - Demonstrate data routing capability by selecting one of multiple input signals based on control inputs.		
TOTAL LAB HOURS		**30 Hours**

Books:

1. Laboratory Manuals
2. Digital Circuits Laboratory Manual: Farzin Asadi
3. Experiments in Digital Electronics: Vijay Bist

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	–	–	–	2	–	–	–	–	–	–	–	–	2	1
CO2	3	–	–	–	2	–	–	–	–	–	–	–	–	2	1
CO3	2	–	–	–	1	–	–	–	–	–	–	–	–	2	–
CO4	3	–	2	–	2	–	–	–	–	–	–	–	–	2	1
CO5	3	–	2	–	2	–	–	–	–	–	–	–	–	2	1
CO6	3	–	–	–	2	–	–	–	–	–	–	–	–	2	1
	2.8	-	2.0	-	1.8	-	-	-	-	-	-	-	-	2.0	1.0

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Program: B. Tech. in EE (BEE)	**Year, Semester: 2nd** Yr., 4th Sem
Course Title: CASD: Foreign Language: French	**Subject Code:** TIU-UEN-S298A
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. Strengthen and expand their communication skills in French.
2. Develop greater fluency in listening, speaking, reading, and writing.
3. Understand and apply more complex grammatical structures and vocabulary.
4. Express ideas in past and future tenses in conversations and written texts.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Recognize and use an expanded range of everyday expressions.	K1
CO-2:	Understand and respond to conversations involving personal experiences.	K2
CO-3:	Use the passé composé and imparfait to talk about past events.	K3
CO-4:	Appraise short narratives, dialogues, and informational texts.	K4
CO-5:	Compose personal letters and messages.	K5
CO-6:	Generate and sustain conversations about familiar topics.	K5

COURSE CONTENT:

MODULE 1:	EXPRESSING PAST EVENTS ● Introduction to passé composé ● Using auxiliary verbs "être" and "avoir" ● Talking about past experiences	**6 Hours**
MODULE 2:	DESCRIBING ROUTINES AND HABITS IN THE PAST ● Introduction to imparfait ● Differences between passé composé and imparfait ● Describing past habits and ongoing actions	**6 Hours**

MODULE 3:	FUTURE PLANS AND INTENTIONS ● Expressing future intentions with "aller + infinitive" ● Talking about upcoming events and travel plans ● Making appointments and invitations	**6 Hours**
MODULE 4:	SHOPPING, SERVICES, AND TRANSACTIONS ● Asking for help and making purchases ● Using expressions of quantity and price ● Talking about preferences and needs	**6 Hours**
MODULE 5:	SOCIAL INTERACTIONS AND EVERYDAY SCENARIOS ● Making polite requests and giving advice ● Expressing opinions and emotions ● Writing informal letters and messages	**6 Hours**
TOTAL LECTURES		**30 Hours**

Books:

Tech French - French for Science and Technology, Goyal Publishers, 2011

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO2	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO3	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO4	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO5	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
	2.0	-	-	-	-	-	-	-	-	3.0	-	-	-	-	-

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 2nd Yr., 4th Sem
Course Title: CASD: Placement grooming	**Subject Code:** TIU-UEE-S298B
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. To develop effective verbal and non-verbal communication skills essential for interviews and professional interactions.
2. To train students in quantitative, logical, and analytical reasoning to perform well in placement tests.
3. To strengthen core technical knowledge and problem-solving skills relevant to electrical engineering job roles.
4. To build confidence and competence in participating in group discussions and facing technical and HR interviews.
5. To guide students in creating impactful resumes and demonstrating professional conduct during placements.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Develop effective communication skills for professional interactions.	K3
CO-2:	Enhance aptitude and reasoning abilities to perform well in placement tests.	K3
CO-3:	Strengthen core technical knowledge and problem-solving skills.	K2
CO-4:	Prepare for group discussions and personal interviews with confidence.	K5
CO-5:	Build professional resumes and demonstrate etiquette in placement scenarios.	K6
CO-6:	Gain practical experience through mock interviews and real-time placement simulations.	K3

COURSE CONTENT:

MODULE 1:	**Communication Skills Development**	**6 Hours**
Verbal and Non-Verbal Communication-Presentation Skills-Email and Business Communication-Public Speaking and Extempore		
MODULE 2:	**Aptitude and Reasoning Training**	**6 Hours**
Quantitative Aptitude: Percentages, Profit & Loss, Ratio & Proportion, Time & Work-Logical Reasoning: Puzzles, Seating Arrangements, Syllogisms-Analytical Reasoning: Data Interpretation, Blood Relations		

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MODULE 3:	**Technical Skill Enhancement**	**6 Hours**
Core Electrical Concepts: Machines, Power Systems, Control Systems-Programming Skills: C, Python, MATLAB-Problem Solving with Real-Life Applications		
MODULE 4:	**Interview Preparation**	**6 Hours**
Personal Interview Techniques-HR Interview Etiquette-Technical Interview Tips		
MODULE 5:	**Professional Development**	**6 Hours**
Resume Building and Cover Letter Writing-LinkedIn Profile Optimization-Professional Etiquette and Dressing		
TOTAL LECTURES		**30 Hours**

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO2	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO3	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO4	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO5	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
CO6	2	–	–	–	–	–	–	–	–	3	–	–	–	–	–
	2.0	-	-	-	-	-	-	-	-	3.0	-	-	-	-	-

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 5th Sem
Course Title: Electrical Power Systems -I	**Subject Code:** TIU-UEE-T305
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for calculation of electric field in various situation.
2. To enable the student to the theoretical basis for calculation of magnetic field in various situation.
3. To enable the student to understand the propagation of electromagnetic wave.
4. To develop the theoretical concepts of electromechanical devices used in industry

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Students will be able to learn the basics of various fundamentals of electrical power generation, transmission & distribution.	K1
CO-2:	Students will be able to learn electrical characteristics of transmission line such as types of transmission lines, various effects on transmission & per unit representation of power system.	K4
CO-3:	Students will be able to gain an overview of how resistance, inductance, and capacitance affect overhead transmission lines.	K2
CO-4:	Students will be able to learn Mechanical design along with the types of insulators also.	K3
CO-5:	The knowledge of voltage distribution across the string and introduction to HV, LV and EHV.	K1
CO-6:	Students will be able to learn information regarding conductors and insulation, different types of underground cable parameters.	K2

COURSE CONTENT:

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MODULE 1:	Overhead transmission lines	12 Hours
Overhead transmission line: Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance. Overhead line construction: Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers.		
MODULE 2:	**Insulators, Corona and Cables**	**10 Hours**
Insulators: Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators. Corona: Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona. Cables: Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.		
MODULE 3:	**Performance of lines**	**8 Hours**
Performance of lines: Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.		
MODULE 4:	**Generation of Electric Power, Tariff and Electricity rules**	**10 Hours**
Generation of Electric Power: General layout of a typical coal fired power station, hydroelectric power station, nuclear power station, their components and working principles, comparison of different methods of power generation. Introduction to Solar & Wind energy system. Tariff: Guiding principle of Tariff, different types of tariffs. Indian Electricity Rule-1956: General Introduction.		
TOTAL LECTURES		**40 Hours**

Books:

1. Power System Engineering by D Kothari, I Nagrath.
2. Electrical Power Systems by C.L. Wadhwa.
3. A Course in Power Systems by J.B. Gupta.

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	–	–	–	–	–	–	–	–	1	–	–	2	1	–
CO2	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO3	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO4	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO5	1	–	–	–	–	–	–	–	–	1	–	–	2	1	–
CO6	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
	1.7	-	-	-	-	-	-	-	-	1.7	-	-	2.0	1.7	-

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 5th Sem
Course Title: Control Systems Engineering	**Subject Code:** TIU-UEE-T307
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for calculation of electric field in various situation.
2. To enable the student to the theoretical basis for calculation of magnetic field in various situation.
3. To enable the student to understand the propagation of electromagnetic wave.
4. To develop the theoretical concepts of electromechanical devices used in industry

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Prepare mathematical models of physical systems and do transfer function analysis.	K2
CO-2:	Do designs of various first order and second order systems based on time responses. Absolute stability.	K4
CO-3:	Understand Relative Stability, Routh-Hurwitz Criteria and its application to Relative Stability Analysis.	K2
CO-4:	Do Root-Locus analysis from transfer functions by construction of Root-loci.	K4
CO-5:	Do frequency response and relative stability analysis by Nyquist criterion, Gain margin, Phase margin etc.	K4
CO-6	Do state space analysis and nonlinear system analysis	K4

COURSE CONTENT:

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MODULE 1:	**Introduction to control problem**	**4 Hours**
Industrial Control examples. Mathematical models. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.		
MODULE 2:	**Time Response Analysis**	**12 Hours**
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Absolute stability, Concept of relative stability. Routh-Hurwitz Criteria and its application to Relative Stability Analysis. Root-Locus technique. Construction of Root-loci.		
MODULE 3:	**Frequency-response analysis**	**12 Hours**
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.		
MODULE 4:	**Introduction to Controller Design**	**8 Hours**
Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of feedback controller design. Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.		
MODULE 5:	**State variable Analysis**	**8 Hours**
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Transformation from Transfer functions to State space equations and vice versa. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.		
MODULE 6:	**Introduction to Optimal Control and Nonlinear Control**	**1 Hour**
Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.		
TOTAL LECTURES		**45 Hours**

Books:

1. Modern Control Engineering- K. Ogata
2. Control Systems Engineering- Norman S. Nise
3. Control Systems- I.J. Nagrath and M. Gopal
4. NPTEL Lecture notes of Control Systems.

CO-PO-PSO MAPPING:

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CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	2	–	–	2	1	–
CO2	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO3	2	–	–	–	–	–	–	–	–	2	–	–	2	1	–
CO4	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO5	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
CO6	2	–	–	–	–	–	–	–	–	2	–	–	2	2	–
	2.0	-	-	-	-	-	-	-	-	2.0	-	-	2.0	1.7	-

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: Electrical Machines – II	**Subject Code:** TIU-UEE-T309
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To enable the student to the theoretical basis for calculation of electric field in various situation.
2. To enable the student to the theoretical basis for calculation of magnetic field in various situation.
3. To enable the student to understand the propagation of electromagnetic wave.
4. To develop the theoretical concepts of electromechanical devices used in industry

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF, distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.	K2
CO-2:	Methods of starting and speed control of IM, Pole changing motor, Deep bar and Double cage rotor, Three-phase induction motor: Construction, materials used, operating principles, types, phasor, slip, equivalent circuit, torque, speed Effect of change in rotor resistance in slip-ring machine and slip power recovery	K3

CO-3:	No-load and blocked rotor test, equivalent circuit parameters, losses, Circle diagram, Space harmonics, induction machine as a generator	K4
CO-4:	Synchronous machines: Constructional and types, generators, motors phasor diagrams, Parallel operation, Power and torque characteristics and capability curves	K4
CO-5:	Salient pole synchronous machine, phasor diagram and determination of synchronous reactance, starting and speed control of synchronous motors.	K4
CO-6:	Single Phase induction motor: Double revolving field theory, development of equivalent circuit, Methods of starting, selection of capacitor value during starting and running	K3

COURSE CONTENT:

MODULE 1:	**Fundamentals of AC Machine Windings**	**6 Hours**
Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single turn coil – active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF, distribution with fixed current through winding concentrated and distributed, Sinusoidally distributed winding, winding distribution factor.		
MODULE 2:	**Pulsating and Revolving Magnetic Fields**	**6 Hours**
Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.		
MODULE 3:	**3- phase Induction Machines**	**12 Hours**
Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque, Equivalent circuit, Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.		
MODULE 4:	**Single-phase induction motors (6 Hours)**	**6 Hours**
Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split phase starting methods and applications.		
MODULE 5:	**Synchronous machines**	**12 Hours**
Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine – two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.		
TOTAL LECTURES		**42 Hours**

Books:

1. Performance and Design of Alternating Current Machines: M.G. Say CBS Publishers & Distributors, SBN: 9788123910277
2. Electrical Machinery: P. S. Bimbhra Khanna Publishers, ISBN 978-8174091734
3. Electric Machines: I. J. Nagrath & D. P. Kothari McGraw Hill Education, isbn978-9352606405

4. Alternating current machines", A. S. Langsdorf, McGraw Hill Education, 1984.
5. Principles of Electric Machines and Power Electronics", P. C. Sen, John Wiley & Sons, 2007, ISBN 9781118078877

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	1	–	–	–	–	–	–	–	2	2	–
CO2	2	–	–	–	2	–	–	–	–	–	–	–	2	2	–
CO3	3	–	2	–	2	–	–	–	–	–	–	–	2	2	–
CO4	3	–	2	–	2	–	–	–	–	–	–	–	2	2	–
CO5	3	–	2	–	2	–	–	–	–	–	–	–	2	2	–
CO6	2	–	–	–	2	–	–	–	–	–	–	–	2	2	–
	2.5	-	2.0	-	1.8	-	-	-	-	-	-	-	2.0	2.0	-

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: Microprocessor and Microcontroller	**Subject Code:** TIU-UEE-T323
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the architecture, instruction set, and interfacing techniques of the 8086 microprocessor and ESP microcontroller.
2. Learn the programming techniques and develop assembly language programs for 8086 and ESP microcontrollers.
3. Analyse memory interfacing, peripheral communication, and interrupt handling in microprocessors and microcontrollers.
4. Develop the ability to interface external devices with the microprocessor/microcontroller and implement real-world applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Explain the architecture, pin configurations, and instruction sets of the 8086 microprocessor and ESP microcontroller.	K2

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CO-2:	Analyse memory addressing, timing diagrams, and interfacing techniques for various peripherals.	K4
CO-3:	Apply assembly language programming concepts for 8086 microprocessor and ESP microcontroller-based systems.	K3
CO-4:	Evaluate the communication protocols, interrupts, and interfacing techniques for external devices.	K5
CO-5:	Design embedded systems integrating microprocessors/microcontrollers with sensors, actuators, and communication modules.	K6
CO-6:	Demonstrate practical implementations of microcontroller-based applications in IoT and automation.	K3

COURSE CONTENT:

MODULE 1:	**Introduction to 8086 Microprocessor**	**12 Hours**
8086 architecture and pin configuration, instruction set and addressing modes, assembly language programming basics, memory segmentation and addressing, interrupt handling and vector table.		
MODULE 2:	**Memory and I/O Interfacing**	**10 Hours**
Memory interfacing techniques (RAM, ROM), I/O interfacing and communication protocols, interrupt service routines (ISR), serial and parallel data communication.		
MODULE 3:	**Introduction to ESP Microcontroller (8 Hours)**	**10 Hours**
ESP microcontroller architecture and pinout, instruction set and programming in C/C++, communication protocols: UART, SPI, I2C, GPIO control and peripheral interfacing.		
MODULE 4:	**Embedded System Development**	**7 Hours**
Sensor interfacing (temperature, humidity, motion, etc.), actuator control (motors, relays, etc.), IoT applications using ESP (Wi-Fi communication, cloud integration), power management and optimization in embedded systems.		
MODULE 5:	**Real-World Applications**	**6 Hours**
Smart home automation using ESP microcontroller, data logging and remote monitoring applications, security and surveillance system design, project-based implementation and case studies.		
TOTAL LECTURES		**45 Hours**

Books:

1. The Intel Microprocessors: Brey
2. The Official ESP32 Book: Ibrahim.

CO-PO-PSO MAPPING:

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CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	1	–	–	–	–	–	–	–	2	2	–
CO2	3	–	–	–	2	–	–	–	–	–	–	–	2	2	–
CO3	3	–	2	–	3	–	–	–	–	–	–	–	3	3	–
CO4	3	–	3	–	2	–	–	–	–	–	–	–	3	3	–
CO5	3	–	3	–	3	–	–	–	–	–	–	–	3	3	–
CO6	2	–	2	–	3	–	–	–	–	–	–	–	2	3	–
	2.7	-	2.5	-	2.3	-	-	-	-	-	-	-	2.5	2.7	-

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 5th Sem
Course Title: Thermal Engineering	**Subject Code:** TIU-UME-E321B
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand thermodynamic systems, properties, and the First Law for energy analysis
2. Apply the Second Law to analyse heat engines, refrigerators, entropy, and efficiency.
3. Study gas power cycles, compare real vs. ideal cycles, and evaluate engine performance.
4. Apply conduction principles, Fourier's Law, and thermal resistance to heat transfer problems.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Identify thermodynamic concepts and the first law of thermodynamics.	K1

CO-2:	Describe the Zeroth and First laws, energy transfer, and steady-flow processes.	K2
CO-3:	Use the second law of thermodynamics and cycles to assess system performance and efficiency.	K3
CO-4:	Evaluate the efficiency and performance of gas power cycles and analyse engine knock.	K4
CO-5:	Solve conduction problems using Fourier's law and concepts of thermal conductivity and composite walls.	K3
CO-6:	Analyse heat transfer mechanisms, including conduction, convection, and radiation, in practical scenarios.	K4

COURSE CONTENT:

MODULE 1:	**Fundamentals of Thermodynamics and Energy Transfer**	**9 Hours**
Thermodynamics and energy, systems and control volumes, intensive and extensive properties, processes and cycles, steady-flow processes, temperature and zeroth law of Thermodynamics, energy transfer by heat and work, mechanical forms of work, First law of Thermodynamics, mass and energy analysis of control volumes.		
MODULE 2:	**Second Law of Thermodynamics and Thermal Cycles**	**7 Hours**
Second law of Thermodynamics: a brief introduction, refrigerators and heat pumps, perpetual motion machines, Carnot cycle		
MODULE 3:	**Gas Power Cycles and Reciprocating Engines**	**9 Hours**
Air standard assumptions for gas power cycles, an overview of reciprocating engines, Otto cycle for spark-ignition engines, Diesel cycle for compression-ignition engines, mean effective pressure, efficiency of these cycles, engine knock.		
MODULE 4:	**Fundamentals of Heat Transfer and Conduction Analysis**	**14 Hours**
Physical origins of heat transfer and rate equations, brief introduction to conduction, convection and radiation, Fourier's law of heat conduction, thermal conductivity, the heat diffusion equation, thermal diffusivity, boundary and initial conditions, one-dimensional steady-state heat conduction, the plane wall/slab, temperature distribution, thermal resistance in conduction, the composite wall.		
TOTAL LECTURES		**39 Hours**

Books:

1. Engineering Thermodynamics by P. K. Nag, McGraw Hill Education.
2. Thermodynamics: An Engineering Approach by Y.A. Cengel and M.A. Boles, McGraw Hill Education (India) Private Limited
3. Fundamentals of Heat and Mass Transfer by F.P. Incropera, D.P. Dewitt, T.L. Bergman and A.S. Lavine, Wiley India Pvt Ltd.
4. Heat and Mass Transfer: Fundamentals and Applications (SIE) by Yunus A. Cengel and Afshin J. Ghajar, McGraw Hill Education
5. Fundamentals of Thermodynamics by C. Borgnakke and R.E. Sonntag, John Wiley and Sons.
6. Fundamentals of Engineering Thermodynamics by M. J. Moran and H. N. Shapiro, Wiley India Pvt. Ltd.

CO-PO-PSO MAPPING:

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CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2	3	–	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3	3	–	2	–	–	–	–	–	–	–	–	–	3	–	–
CO4	3	–	3	–	–	–	–	–	–	–	–	–	3	–	–
CO5	3	–	3	–	–	–	–	–	–	–	–	–	3	–	–
CO6	3	–	3	–	–	–	–	–	–	–	–	–	3	–	–
	2.8	-	2.8	-	-	-	-	-	-	-	-	-	2.8	-	-

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 5th Sem
Course Title: Object Oriented Programming with C++ and Java	**Subject Code:** TIU-UEE-E321
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand and utilize the core OOP concepts
2. Develop comprehensive software packages using C++ and/or Java
3. Develop, implement and distribute technical software packages.
4. Utilize their understanding of the languages to dive deeper in furthering their understanding of databases, web technologies, mobile apps, etc.

COURSE OUTCOME:

On completion of the course, the student will be able to:

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CO-1:	Understand and use the idea of encapsulation in software development.	K2
CO-2:	To develop programs with reusability.	K4
CO-3:	Use the principles of data abstraction, inheritance, polymorphism, virtual functions, etc.	K4
CO-4:	To handle files, I/O and exceptions.	K3
CO-5:	To develop multi-platform apps.	K4
CO-6:	To design efficient GUI applications.	K6

COURSE CONTENT:

MODULE 1:	**General concepts of Object-Oriented Programming (OOP)**	**6 Hours**
Objects, data abstractions, information hiding and encapsulation. Classes: constructors, destructors and object creation. Name spaces and references. Class methods, method overloading. Inheritance. Polymorphism. Abstract classes. Exceptions and exception handling. Templates.		
MODULE 2:	**C++**	**18 Hours**
C++ standard library, header files, inline functions, scope resolution, function overloading, function templates, basic object technology and the UML, C++ vector class template. Classes, different types of data members, default member-wise assignment, member functions, using the "this" pointer, static class members. Operator overloading: overloading binary operations and binary stream operations and unary operations. Overloading the function call operator "()". Inheritance. Thorough analysis of base and derived classes. Polymorphism. Type fields, virtual functions, runtime typecasting. Exception handling. Re-throwing, stack unwinding, exception hierarchy. Class and function templates. Template overloading.		
MODULE 3:	**Java**	**21 Hours**
History and features of Java. C++ vs Java. JDK, JRE, and JVM (Java Virtual Machine). Unicode system, operators, keywords, and control statements. Class, object, and types of classes. Object declaration and initialization. Life cycle of an object. Anonymous objects. Packages. User-defined packages, built-in packages. Importing packages. Data types. Primitive data types, non-primitive data types. Memory allocation of primitive and non-primitive data types, etc. Methods. Predefined method, user-defined methods: instance methods, static methods Constructors. Default and parameterized constructors. Constructor overloading and chaining in Java. Modifiers. Access modifiers and a non-access modifiers. Static and Final keywords. "super" and "this" keywords. Class, object, encapsulation, inheritance, polymorphism, and abstraction. Collections. Exception handling. Try catch finally and throw.		
TOTAL LECTURES		**45 Hours**

Books:

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1. B. Stroustrup: The C++ Programming Language
2. Deitel: C++ How to Program
3. Deitel: Java How to Program, Early Objects Edition
4. Arnold, Gosling: The Java Programming Language

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	–	–	1	–	–	–	–	–	–	–	–	2	2
CO-2	3	3	3	–	2	–	–	–	–	–	–	–	2	3	3
CO-3	3	3	3	–	2	–	–	–	–	–	–	–	2	3	3
CO-4	2	2	–	2	2	–	–	–	–	–	–	–	1	2	2
CO-5	3	3	3	2	3	–	–	–	–	–	–	–	2	3	3
CO-6	3	3	3	2	3	–	–	–	2	2	–	–	2	3	3
	2.7	2.7	3.0	2.0	2.2	-	-	-	2.0	2.0	-	-	1.8	2.7	2.7

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: Microprocessor and Microcontroller Lab	**Subject Code:** TIU-UEE-L323
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the architecture and instruction set of microprocessors and microcontrollers.
2. Develop assembly language programs for arithmetic operations, data manipulation, and control flow.
3. To Interface microprocessors with peripheral devices to implement real-world applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Identify and understand the architecture and functionality of microprocessors.	K1

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CO-2	Develop assembly language programs for fundamental arithmetic and logical operations.	K2
CO-3	Implement memory and I/O interfacing with microprocessors.	K3
CO-4	Analyse interrupt handling and hardware control using assembly programming.	K3
CO-5	Design and implement microprocessor-based real-world applications.	K4
CO-6	Evaluate the efficiency and optimization of microprocessor-based systems.	K4

COURSE CONTENT:

Module 1	**Study of Assembly Language Programming Basics**	**9 Hours**
Study the architecture, instruction set, and basic syntax of assembly language. Focus on writing and executing simple arithmetic programs and understanding data representation.		
Module 2	**Analysis of Complex Arithmetic and Data Handling**	**9 Hours**
Analyze how structured arithmetic operations like multiplication, division, searching, and sorting are implemented using assembly language techniques.		
Module 3	**Exploration of Memory and I/O Interfacing Techniques**	**6 Hours**
Explore how microprocessors communicate with external components. Learn interfacing techniques involving LEDs and switches to create interactive control systems.		
Module 4	**Investigation of Interrupts and Timer-Based Control**	**9 Hours**
Investigate interrupt service routines and timer controls to manage real-time responses using software and hardware interrupts in 8086 assembly language.		
Module 5	**Design and Integration of Real-Time Microprocessor Applications**	**9 Hours**
Design and integrate real-world systems such as digital stopwatches and sound synthesizers. Apply knowledge of interfacing, timing, and control to develop functional prototypes.		
TOTAL LAB CLASSES:		**42 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	2	3	2	-	2	-	-	-	-	-	-	-	2	3	2
CO-3	3	3	3	-	3	-	-	-	-	-	-	-	2	3	2
CO-4	3	3	3	2	3	-	-	-	-	-	-	-	2	3	2
CO-5	3	3	3	2	3	-	-	-	2	2	-	-	2	3	2
CO-6	3	3	3	3	3	-	-	-	2	2	-	-	2	3	2
	2.7	2.8	2.8	2.3	2.5	-	-	-	2.0	2.0	-	-	2.0	2.8	2.0

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Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: Power Systems Lab -I	**Subject Code:** TIU-UEE-L315
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Familiarize with Power System Equipment – Introduce students to essential power system components such as transmission lines, transformers, and generators.
2. Understand Measuring Instruments – Provide knowledge on the use of power system measuring instruments like voltmeters, ammeters, wattmeters, and power analysers.
3. Analyse Transmission Line Characteristics – Conduct experiments to determine transmission line parameters such as resistance, inductance, capacitance, voltage regulation, and efficiency.
4. Perform Fault Analysis – Study and analyse different types of faults (short circuits, open circuits) and understand their impact on power systems.

5. Enhance Problem-Solving Skills – Develop practical skills to apply theoretical concepts for diagnosing and troubleshooting power system issues.
6. Encourage Safety Practices – Emphasize the importance of safety procedures and standards in handling high-voltage equipment and conducting power system experiments.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Identify and understand the basic components and measuring instruments used in power system experiments.	K1
CO-2:	Explain the working principles of various transmission line models and electrical machines used in power systems.	K2
CO-3:	Perform experiments to determine the parameters of transmission lines, transformers, and alternators.	K3
CO-4:	Analyse the performance of transmission lines under different loading conditions using experimental setups.	K4
CO-5:	Examine different types of faults in power systems using protection relays and fault analysis kits.	K4
CO-6:	Evaluate the efficiency, voltage regulation, and power factor of electrical machines and power system components.	K4

COURSE CONTENT:

MODULE 1:	Insulators Type	**6 Hours**
Introduction to Insulators. Overview of insulators and their role in power systems - Classification of insulators based on material, structure, and application		
MODULE 2:	Dielectric Strength	**15 Hours**
Factors affecting dielectric strength (material composition, temperature, moisture, aging, etc.)- Observing failure modes (thermal, electrical, or mechanical breakdown)- - Factors affecting transformer oil performance (moisture, temperature, contamination) - Properties of Transformer Oil.		
MODULE 3:	Transmission Line	**12 Hours**
Introduction to Transmission Line Constants - Transmission line classification: Short, Medium, and Long lines - Generalized Circuit Model of a Transmission Line -Concept of ABCD parameters.		
MODULE 4:	DC Distribution	**9 Hours**
Introduction to DC Distribution Systems - Overview of DC distribution networks - Types of DC distribution- Analyse voltage drops and power losses in the network - Understand the effect of load variation on distribution performance		
TOTAL LAB HOURS		**42 Hours**

CO-PO-PSO MAPPING:

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CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	-	-	1	-	-	-	-	-	-	-	2	2	-
CO-2	2	3	2	-	2	-	-	-	-	-	-	-	2	3	2
CO-3	3	3	3	-	3	-	-	-	-	-	-	-	2	3	2
CO-4	3	3	3	2	3	-	-	-	-	-	-	-	2	3	2
CO-5	3	3	3	2	3	-	-	-	2	2	-	-	2	3	2
CO-6	3	3	3	3	3	-	-	-	2	2	-	-	2	3	2
	2.7	2.8	2.8	2.3	2.5	-	-	-	2.0	2.0	-	-	2.0	2.8	2.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: Control Systems Engineering Lab	**Subject Code:** TIU-UEE-L317
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. To develop a fundamental understanding of MATLAB / SCILAB for simulating and analysing control systems.
2. To apply computational tools for analysing linear time-invariant (LTI) systems in time and frequency domains.

3. To study the characteristics and performance of electromechanical control devices, such as stepper motors and synchro devices.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Utilize MATLAB / SCILAB for basic mathematical operations and simulations related to control systems.	K1
CO-2	Simulate and analyse the transient response of LTI systems to different inputs using computational tools.	K2
CO-3	Represent and evaluate SISO LTI systems in state-space form using MATLAB/SCILAB.	K3
CO-4	Perform frequency domain analysis of control systems using Bode plots, Nyquist plots, and Nichols plots.	K3
CO-5	Conduct root locus analysis for stability and performance assessment of control systems.	K3
CO-6	Understand and examine the working principles of stepper motors and synchro devices in control applications.	K4

COURSE CONTENT:

Module 1	**Introduction to MATLAB/ Scilab for Control Systems**	**6 Hours**
Introduces the fundamental programming and simulation environment of MATLAB and Scilab. Students will learn to perform mathematical operations, plotting, and basic system modeling.		
Module 2	**Transient Response Analysis of LTI Systems**	**6 Hours**
Focuses on analyzing how systems respond to standard inputs like step, impulse, and ramp functions. Simulation of time-domain characteristics of first and second-order systems.		
Module 3	**State-Space Representation and Analysis**	**6 Hours**
Covers transformation of transfer functions to state-space models and evaluation of system response using state variables. Involves concepts of controllability and observability.		
Module 4	**Frequency Domain Analysis of LTI systems**	**6 Hours**
Students will use frequency response tools such as Bode plots, Nyquist plots, and Nichols charts to assess stability margins and resonance in systems.		
Module 5	**Root Locus Analysis**	**3 Hours**
Teaches how to sketch and analyze root locus plots to understand the movement of poles and zeros, helping in control system design and stability evaluation.		
Module 6	**Stepper Motor and Synchro Systems**	**6 Hours**
Explores the structure and functioning of electromechanical actuators like stepper motors and synchro's. Includes simulation and control applications.		

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Module 7	**PID Controller Design and Simulation**	**6 Hours**
Emphasizes the design and simulation of PID controllers in MATLAB. Students will tune parameters and observe the effect on system performance and stability.		
Module 8	**Real-World Control System Implementation & Review**	**6 Hours**
Students apply their knowledge to implement and simulate a real-world control system using MATLAB/Simulink. Focus on validation, tuning, and performance review.		
TOTAL LAB CLASSES:		**45 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	-	-	3	-	-	-	-	-	-	-	2	3	2
CO-2	3	3	2	2	3	-	-	-	-	-	-	-	2	3	3
CO-3	3	3	3	2	3	-	-	-	-	-	-	-	2	3	3
CO-4	3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO-5	3	3	3	3	3	-	-	-	2	-	-	-	2	3	3
CO-6	2	2	2	3	2	-	-	-	-	-	-	-	2	3	3
	2.7	2.7	2.6	2.6	2.8	-	-	-	2.0	-	-	-	2.0	3.0	2.8

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 5th Sem
Course Title: Electrical Machines Lab -II	**Subject Code:** TIU-UEE-L319
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

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1. To familiarize students with more conversant about the underlying energy conversion theory between electrical and mechanical systems by introducing electromechanical energy conversion principles.
2. To expose the students to the concepts of various types of electrical machines and applications of electrical machines.
3. To develop the ability to diagnose faults and perform maintenance on electrical or mechanical machines.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Explain the fundamental principles, construction, and working of advanced electrical/mechanical machines.	K1
CO-2	Explain the fundamental principles, construction, and working of advanced electrical/mechanical machines.	K2
CO-3	Conduct experiments on AC/DC machines, transformers, and synchronous machines to evaluate efficiency and performance.	K3
CO-4	Demonstrate troubleshooting techniques for diagnosing faults and maintaining electrical or mechanical machines.	K3
CO-5	Compare different control techniques for speed, torque, and efficiency optimization in electrical/mechanical machines.	K4
CO-6	Assess the impact of automation and digital control systems on machine operations and industrial applications.	K4

COURSE CONTENT:

Module 1	**3-Phase Squirrel Cage Induction Motor**	**6 Hours**
Determining equivalent circuit parameters using no-load and blocked rotor tests. Evaluating performance characteristics: core loss, friction & windage loss, short circuit parameters.		
Module 2	**Polarity Test of Transformer**	**6 Hours**
Determining polarity using DC or AC voltage method. Verifying additive or subtractive polarity for parallel operation. Polarity refers to the instantaneous relative direction of voltage in primary and secondary windings.		
Module 3	**Open Circuit and Short Circuit tests on a Three Phase Alternator and voltage regulation by synchronous-impedance method**	**9 Hours**
Open Circuit and Short Circuit tests on a three-phase alternator, voltage regulation by Synchronous Impedance Method. Voltage regulation as terminal voltage changes from no-load to full-load at constant speed and excitation. Synchronous Impedance Method using OC and SC characteristics.		
Module 4	**V-Curve of a Synchronous Motor**	**9 Hours**
Constant power input. Variation of input current and power factor with excitation changes. Connection to infinite bus bars. Applied voltage balanced by excitation voltage and synchronous impedance drop.		
Module 5	**speed control of a three-phase induction motor**	**6 Hours**

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Squirrel cage motor, winding adjustments, pole variation, stator tapings, synchronous speed, frequency dependence.		
Module 6	**Synchronization of a 3-phase alternator to the infinite bus bars and effect of change of excitation of the Synchronous machine**	**6 Hours**
Synchronization of a 3-phase alternator to infinite bus bars, effect of excitation and input changes. Voltage magnitude, frequency, phases sequence matching. Incoming machine and bus bar voltages in phase.		
TOTAL LAB HOURS:		**42 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-3	3	3	3	-	2	-	-	-	-	-	-	-	3	3	3
CO-4	3	3	3	-	2	-	-	-	2	-	-	-	3	3	3
CO-5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO-6	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
	2.7	2.8	3.0	3.0	2.3	-	-	-	2.0	-	-	-	2.7	2.7	2.7

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: CASD: Programming Language: C & Python	**Subject Code:** TIU-UEE-S301A
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

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COURSE OBJECTIVE:

Enable the student to:

1. Introduce students to fundamental programming concepts using C and Python, including syntax, data types, operators, and control structures.
2. Develop problem-solving skills by writing structured, modular, and efficient programs in C and Python.
3. Enable students to implement algorithms and data structures to optimize code performance and memory usage.
4. Provide hands-on experience in file handling, functions, and object-oriented programming to enhance software development skills.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand fundamental programming concepts, syntax, and control structures in C and Python.	K2
CO-2:	Apply programming concepts to develop structured C and Python programs for problem-solving.	K3
CO-3:	Analyse algorithms, functions, and memory management techniques to write optimized and efficient code.	K4
CO-4:	Design and implement object-oriented concepts, file handling, and error handling in Python.	K4
CO-5:	Develop small-scale applications using C & Python for electrical engineering-related problem-solving.	K4
CO-6:	Demonstrate real-world applications by integrating Python with IoT devices, microcontrollers, and electrical hardware.	K3

COURSE CONTENT:

MODULE 1:	**Introduction to Programming & Basics of C**	**6 Hours**
Fundamentals of programming, Flowcharts, Algorithms - Introduction to C, Structure of a C program - Data types, Constants, Variables, Operators, and Expressions - Input/Output functions in C - Control Structures: Conditional Statements (if, if-else, switch), Loops (for, while, do-while)		
MODULE 2:	**Functions, Arrays & Pointers in C**	**6 Hours**
Functions: User-defined and Built-in Functions- Arrays: Single & Multi-dimensional Arrays - Pointers and Dynamic Memory Allocation - String Handling in C		
MODULE 3:	**Structures, File Handling & Debugging in C**	**6 Hours**
Structures and Unions in C - File Handling: Reading & Writing Files - Debugging & Error Handling in C		
MODULE	**Introduction to Python Programming**	**6 Hours**

4:		
Basics of Python, Data Types, Variables, and Operators - Control Statements in Python: Conditional and Looping Constructs - Functions & Modules in Python		
MODULE 5:	**Advanced Python Concepts**	**9 Hours**
Lists, Tuples, and Dictionaries - File Handling in Python - Introduction to Object-Oriented Programming in Python		
MODULE 6:	**Applications of C & Python in Electrical Engineering**	**6 Hours**
Solving mathematical and electrical engineering problems using C & Python - Interfacing with hardware using Python (e.g., Raspberry Pi, Arduino) - Case Study on IoT applications in Electrical Engineering		
TOTAL LECTURES		**39 Hours**

Books:

1. Let Us C – Yashwant Kanetkar
2. Programming in ANSI C – E. Balagurusamy
3. Python Programming: A Modern Approach – Vamsi Kurama
4. Python Crash Course – Eric Matthes
5. Automate the Boring Stuff with Python – Al Sweigart

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO-2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	-
CO-3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	-
CO-4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	-
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2
CO-6	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
	2.8	2.8	2.8	2.0	3.0	-	-	-	-	-	-	-	2.8	2.8	2.5

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 5th Sem
Course Title: CASD: SAP	**Subject Code:** TIU-UEE-S301B
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

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COURSE OBJECTIVE:

Enable the student to:

1. To familiarize students with the fundamental concepts of SAP (Systems, Applications, and Products) and ABAP (Advanced Business Application Programming) and their applications in electrical engineering.
2. To equip students with programming skills in ABAP, including syntax, data types, and modularization techniques.
3. To explore the integration of SAP modules with electrical engineering processes and data management.
4. To develop skills in solving real-world electrical engineering problems using SAP-ABAP programming and customization.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To equip participants with the skills and knowledge necessary to develop and maintain SAP applications using the ABAP programming language.	K3
CO-2	To understand the steps for database-handling using SAP	K2
CO-3	To understand the procedure for ALV report generation.	K2
CO-4	To apply different structures and programming techniques in ABAP.	K3
CO-5	Integrate ABAP applications with database tables and user interfaces (screens/forms)	K3
CO-6	Analyse the use of ABAP Workbench tools in developing customized business applications	K4

COURSE CONTENT:

MODULE 1:	**SAP System Architecture**	**4 Hours**
SAP System Architecture and flow of a program		
MODULE 2:	**Object Navigator, Repository and ABAP Programs**	**4 Hours**
SAP Object Navigator and Repository - Developing Programs and Organizing Developments - Creating Packages - Developing a Program in ABAP - Creating Transaction in SAP-How to add Transactions to your Personal Favourites - How to create an ABAP program		
MODULE 3:	**Basic ABAP statements, ABAP Structures and ABAP Logical Expressions**	**4 Hours**
Working with Elementary Data Objects-Basic ABAP statements-Performing ABAP calculations - ABAP Calculator - ABAP Conditional Statements - ABAP Logical Expressions - ABAP Loops - ABAP Search Helps F4 - ABAP Elementary Search Help - String Manipulation		
MODULE 4:	**Selection Screen In ABAP**	**4 Hours**

Radio Button - Check Box		
MODULE 5:	**ABAP Object Oriented Programming**	**4 Hours**
Concept of OOP - Creating Class - Creating Object - Methods - Creating Interface		
MODULE 6:	**Creating Structure In ABAP**	**4 Hours**
MODULE 7:	**Transparent Tables in the ABAP Dictionary**	**4 Hours**
Data Modelling and ABAP Dictionary - How to create transparent tables - Table Maintenance Generator - Viewing data in transparent tables		
MODULE 8:	**ABAP Database Handling**	**4 Hours**
Concept of Data Base - Open SQL - Modification of Transparent Table using Open SQL - SAP Data Retrieval Using a Select Loop - Open SQL ABAP JOIN Statement		
MODULE 9:	**ABAP Subroutines**	**4 Hours**
ABAP Subroutines and procedures - ABAP Modularization - ABAP Include Programs		
MODULE 10:	**ABAP ALV Grid Control**	**4 Hours**
Overview of ALV Programming - ALV Report Generation		
TOTAL LECTURES		**40 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3
CO-3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO-4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3
CO-5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
CO-6	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
	2.8	2.8	2.8	2.0	3.0	-	-	-	-	-	-	-	2.8	2.8	2.8

Department of Electrical Engineering

SEMESTER 6

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Electrical Power Systems-II	**Subject Code:** TIU-UEE-T302
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. understand the procedure and necessity of determining all the steady-state network state variables of the power-network at any operating condition.
2. understand the concept of short-circuit fault level, steady-state and transient stability and the limitations these concepts impose during practical operation or system design.
3. understand the need of protection of electrical equipment, their protection schemes, switchgear and the effect of different types of faults in the power network.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To obtain per-unit representation of power system and state its advantages & state the various equipment used in substations and understand their usage.	K3
CO-2:	To analyse the network by calculating the state-variables for different operating conditions and assess the mathematical tools employed in terms of their computational requirements during software implementation.	K4
CO-3:	To evaluate fault currents for different types of faults on the power network.	K4
CO-4:	To understand concept of steady-state and transient stability and assess the limitations these factors impose during practical operation or system design.	K4
CO-5:	To understand the need and working of protection schemes and relaying equipment.	K2
CO-6:	To analyse the transients produced by circuit-breaker operation and to understand working of different types of switchgear.	K4

COURSE CONTENT:

MODULE 1:	**REPRESENTATION OF POWER SYSTEM COMPONENTS**	**2 Hours**
Single-phase representation of balanced three phase networks, the one-line diagram and the impedance or reactance diagram, per unit (PU) system.		
MODULE 2:	**DISTRIBUTION SUBSTATION**	**4 Hours**

Graphical representation of data, Frequency distributions, Measures of central tendencies – mean, median, mode, Measures of dispersion – standard deviation, variance, Principle of Least Squares, curve fitting, regression analysis.		
MODULE 3:	**POWER FLOW ANALYSIS**	**8 Hours**
Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.		
MODULE 4:	**FAULTS IN ELECTRICAL SYSTEMS**	**8 Hours**
Transient on a transmission line, short circuit of a synchronous machine under no load & loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, single line-to –ground fault, line-to-line fault, double line-to- ground fault.		
MODULE 5:	**STABILITY CONSTRAINTS IN SYNCHRONOUS GRIDS**	**6 Hours**
Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th} order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.		
MODULE 6:	**POWER SYSTEM PROTECTION SCHEMES**	**10 Hours**
Protective zones, Relaying elements and quantities. Protective relays, basic requirements and type of protection, phase and amplitude comparator, grading (time & current), classification of Electromagnetic relays, Directional relay, Distant relay, Differential relay, basic aspects of static and digital relays, relay protection scheme for transformer, feeder, generators and motors.		
MODULE 7:	**CIRCUIT BREAKERS**	**10 Hours**
Circuit breakers, circuit breaking transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, arc and arc extinction, circuit breaker types, oil circuit breaker, vacuum circuit breaker, air blast circuit breaker, SF6 circuit breaker and operating mechanism, advantages and disadvantages of different types.		
TOTAL LECTURES		**48 Hours**

Text books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
4. Switchgear protection and power systems, Sunil S Rao, Khanna Publications.
5. A text book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S. Bhatnagar & A. Chakrabarti, Dhanpat Rai & CO.

References

Department of Electrical Engineering

NPTEL course problems of “Power System Analysis” conducted by IIT Kharagpur

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	-	2	-	-	-	-	-	-	-	-	-	2	3	2
CO-2	3	2	3	3	-	-	-	-	-	-	-	-	3	3	3
CO-3	3	2	2	3	-	-	-	-	-	-	-	-	3	3	3
CO-4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	3
CO-5	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-6	3	2	2	2	-	-	-	-	-	-	-	-	3	3	3
	2.8	2.3	2.4	2.8	-	-	-	-	-	-	-	-	2.7	2.8	2.7

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Digital Signal Processing	**Subject Code:** TIU-UEE-T308
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. To represent signals mathematically in discrete time domain.
2. To understand the analysis of discrete-time systems using z-transform.
3. To understand the Discrete Time Fourier Transform (DTFT), Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. To learn the design techniques and hardware structure realizations of FIR and IIR filters.
5. To learn real life applications of digital signal processing.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Represent various LTI discrete-time signals and systems with their properties in time domain.	K3
CO-2:	To analyse response and stability of LTI discrete time systems for various types of Input signals in z-domain.	K4
CO-3:	To compute aliased or non-aliased versions of system responses by DFT-IDFT method using Twiddel factor matrix and also compute DFTs by FFT algorithms.	K3
CO-4:	To design FIR digital filters of various Oeder using various windowing techniques and IIR digital filters of various types and orders in Butterworth and Chebyshev Type-I techniques.	K4
CO-5:	To apply digital signal processing for the analysis of real-life signals.	K3
CO-6:	Compare and critique different signal processing algorithms for real-time applications like audio, speech, and image processing.	K4

COURSE CONTENT:

MODULE 1:	**Discrete-time signals and systems**	**8 Hours**
Discrete time signals or Sequence, Sampling and reconstruction of signals, Aliasing, Sampling theorem and Nyquist rate. Various types of Discrete time signals, Basic operations, Standard basic Discrete time signals and their properties, Energy and Power signals, Discrete Tme systems and their properties, Causal, Anticausal,		

Noncausal systems, Discrete Convolution sum, Various Example problems on various topics.		
MODULE 2:	**Z-transform**	**10 Hours**
z-Transform definition, Region of Convergence (ROC), Properties of z-transform for causal and noncausal signals, Inverse z-transforms, Various methods. Interpretation of stability in z-domain, Relation between causality, noncausality, ROC and stability, Parseval's Identity, Analysis of Linear Shift Invariant systems using z-transform, Example problems on various topics.		
MODULE 3:	**Discrete Fourier Transform**	**10 Hours**
Discrete Time Fourier Transforms (DTFT) and their properties, Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT), Properties of DFT, Convolution of signals, Aliasing, Matrix formulation of DFT in terms of Twiddle factors, Properties of Twiddle factors. Implementation of Discrete Time Systems, Example problems on various topics. Fast Fourier Transform Algorithm, definition, Butterfly diagrams of 2-point, 4-point, 8-point DIT-FFT and DIF-FFT.		
MODULE 4:	**Design of Digital filters**	**11 Hours**
Introduction of FIR and IIR Digital filters, Comparison between FIR and IIR Digital filters, ffect finite register length in FIR filter design, Design of FIR Low-pass, Band-pass, Band-stop and High-pass Digital filters by Windowing methods, Structure realization of FIR filters, Design of IIR Digital filters By Buttreworth and Chebyshev algorithms for Low-pass, Band-pass, Band-stop and High-pass, Example problems on various topics.		
MODULE 5:	**Special Topics of Digital Signal Processing**	**6 hours**
Multi-rate Signal Processing, Wiener Filter, Finite Word Length effect, Power spectrum Estimation, DSP processors, Practical Applications.		
TOTAL LECTURES		**45 Hours**

Books:

1. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall
2. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice-Hall International, INC.
3. T.K. Rawat, "Digital Signal Processing", Oxford University Press.
4. NPTEL Lecture notes of Digital Signal Processing.

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CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	-	3	-	-	-	-	-	-	-	-	-	3	3	-
CO-2	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
CO-3	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
CO-4	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
CO-5	3	-	3	-	-	-	-	-	-	-	-	-	3	3	-
CO-6	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
	3.0	-	3.0	3.0	-	-	-	-	-	-	-	-	3.0	3.0	-

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Power Electronics	**Subject Code:** TIU-UEE-T310
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Understand the differences between signal level and power level devices.
2. Analyse controlled rectifier circuits.
3. Analyse the operation of DC-DC choppers.
4. Analyse the operation of inverters.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To understand the Power electronics components.	K2
CO-2:	To analyse and design of controlled rectifiers for consumer electronics and industrial applications.	K4
CO-3:	To analyse the performance of rectifiers.	K4
CO-4:	To understand the operation of Choppers	K2
CO-5:	To understand the operation and performance of inverters.	K2
CO-6:	To create new type of converters and inverters for special applications.	K6

COURSE CONTENT:

MODULE 1:	**Power switching devices**	**12 Hours**
Introduction, Concept of Power Electronics, Applications of power electronics, Advantages and disadvantages of power-electronic converters, Power electronic systems, Power semiconductor devices, Types of power electronic converters, Power electronic modules, Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.		
MODULE 2:	**Thyristor rectifiers**	**9 Hours**
Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.		
MODULE 3:	**DC-DC buck converter**	**6 Hours**
Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage.		
MODULE 4:	**DC-DC boost converter**	**6 Hours**

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.		
MODULE 5:	**Single-phase voltage source inverter**	**6 Hours**
Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage.		
MODULE 6:	**Three-phase voltage source inverter**	**6 Hours**
Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation.		
TOTAL LECTURES		**45 Hours**

Books:

1. M. H. Rashid, “Power electronics: circuits, devices, and applications”, Pearson Education, India, 2009.
2. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
4. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
5. M D Singh and K B Khanchandani, “Power Electronics”, McGraw Hill.
6. P. S. Bimbhra, “Power Electronics”, Khanna Publishers.

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO-2	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
CO-3	3	-	3	3	-	-	-	-	-	-	-	-	3	3	-
CO-4	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO-5	3	-	-	-	-	-	-	-	-	-	-	-	3	3	-
CO-6	3	-	3	3	-	-	-	-	-	-	-	-	3	3	3
	3.0	-	3.0	3.0	-	-	-	-	-	-	-	-	3.0	3.0	3.0

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Principle of Management	**Subject Code:** TIU-UMG-T392
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. To understand the in-depth concept of management.
2. To comprehend the concept of organizational Departmentalization.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To understand the basic concepts, principles, and theories of management.	K2
CO-2	To Understand the significance of planning and strategic management	K2
CO-3	To Understand the application of the principles of management to the functioning of an organization	K4
CO-4	To Understanding the significance of motivational techniques	K3
CO-5	To understand the use of computer-based tools for management	K2
CO-6	Analyse organizational structures, leadership styles, and communication methods in various management environments.	K4

COURSE CONTENT:

MODULE 1:	**Management**	**10 Hours**
Definition of management, science or art, manager vs entrepreneur; Types of managers, managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.		
MODULE 2:	**Planning and Control**	**10 Hours**
Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.		
MODULE 3:	**Decision Making and Organizing**	**10 Hours**
Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.		
MODULE 4:	**Staffing and Motivation**	**10 Hours**

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Directing, individual and group behaviour, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication. Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.	
TOTAL LECTURES	**40Hours**

Books:

1. Greenberg Jerald and Baron Robert A.: Behaviour in Organisations: Understanding and Managing the Human Side of Work, Prentice Hall of India.
2. Kaul Vijay Kumar, Business Organisation & Management - Text and Cases, Pearson.
3. Kaul, Vijay Kumar, Management- Text & Cases, Vikas Publication.
4. Kavita Singh: Organisational Behaviour, Vikas Publication.

Reference Books:

1. Koontz & Heinz Weihrich: Essential of Management, McGraw Hill.
2. Luthans Fred: Organisational Behaviour, Tata McGraw Hill.
3. Mc Shane L. Steven, Glinow Mary Ann Von & Sharma Radha R. – Organisational Behaviour; Tata McGraw Hill.
4. Newstrom John W.: Organisational Behaviour, Tata McGraw Hill.
5. Richard L. Daft: Principles of Management, Cengage Learning India.

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	-	2	3	-	-	2	3	-	-	2	2	-
CO-2	3	3	2	-	2	3	-	-	2	3	-	-	2	2	-
CO-3	3	3	2	-	2	3	-	-	3	3	-	-	2	2	-
CO-4	3	3	2	-	2	3	-	-	3	3	-	-	2	2	-
CO-5	3	3	3	-	3	3	-	-	2	3	-	-	2	2	-
CO-6	3	3	3	-	3	3	-	-	3	3	-	-	2	2	-
	3.0	3.0	2.3	-	2.3	3.0	-	-	2.5	3.0	-	-	2.0	2.0	-

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 6th Sem
Course Title: Instrumentation and Process Control	**Subject Code:** TIU-UEE-E316B
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

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COURSE OBJECTIVE:

This course enables the students:

1. **Understanding Measurement Systems** – Introduce students to the fundamental concepts of measurement systems, including the characteristics and performance of sensors, transducers, and measurement techniques.
2. **Sensor and Transducer Applications** – Familiarize students with various sensors and transducers used for measuring electrical and non-electrical quantities such as temperature, pressure, flow, level, and displacement.
3. **Signal Conditioning and Data Acquisition** – Teach students about signal conditioning techniques, including amplification, filtering, and analog-to-digital conversion, along with data acquisition systems.
4. **Process Control Fundamentals** – Develop an understanding of process control principles, including open-loop and closed-loop control systems, PID controllers, and their tuning methods.
5. **Dynamic Behavior of Control Systems** – Analyze the dynamic response of first-order, second-order, and higher-order systems, along with stability criteria and time-domain and frequency-domain analysis.
6. **Industrial Controllers and Control Strategies** – Introduce various industrial control strategies, including cascade control, feedforward control, ratio control, and adaptive control techniques.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To understand basic sensors used in process industries	K2
CO-2	To understand various controllers used in industries for process control	K2
CO-3	To analyse the performance of various controllers	K4
CO-4	To understand the operation of pneumatic and hydraulic controllers	K2
CO-5	To understand the operation of Programmable controllers	K2
CO-6	To create new type of industrial control system.	K6

COURSE CONTENT:

MODULE 1:	**Introduction**	**2 Hours**
General measurement system. Introduction to transducers. Signal conditioning systems for transducers. Linearization of sensors.		
MODULE 2:	**Displacement Transducer**	**4 Hours**
Measurement of displacement using linear variable differential transducers (LVDTs). Null reduction techniques. Phase compensation circuits. Phase sensitive demodulation. Synchronous demodulation. Introduction to rotary variable differential transducers (RVDTs).		
MODULE 3:	**Capacitive transducers**	**4 Hours**

Variable air gap, variable plate overlap, variable dielectric. Level gauge. Thickness gauge. Humidity sensor. Capacitive microphone. Signal conditioning circuits for capacitive transducers: reactive bridges, transformer ratio bridges, multivibrator circuits, op-amp based circuits.		
MODULE 4:	**Piezoelectric transducers**	**4 Hours**
Fundamental concepts, materials, charge sensitivity, voltage sensitivity. Force/displacement transducers. Buffer amplifiers, charge amplifiers. Static and dynamic responses. Accelerometers		
MODULE 5:	**Flow Measurement**	**4 Hours**
Hot wire anemometers: constant-current and constant temperature varieties for measurement of static and dynamic flow. Dynamic compensation, Electromagnetic flow meters: DC, AC and interrupted DC excitation for magnet system. Ultrasonic transit-time flow meters: ultrasonic link, wetted-type and non wetted type varieties.		
MODULE 6:	**Pressure transducers**	**2 Hours**
Primary sensing elements: bourdon tube, diaphragm, bellows, Electronic pressure gauges, Capacitive pressure transducers.		
MODULE 7:	**Magnetostrictive transducers**	**2 Hours**
Basic concepts. Torque measurement using magneto strictive sensing		
MODULE 8:	**Active filters**	**7 Hours**
Filter approximations Techniques: Butterworth, Chebyshev. Realization of Active Filter circuits. State-variable filter. Switched capacitor filter circuits.		
MODULE 9:	**Data Converters**	**5 Hours**
DAC: Binary-weighted register, R-2R ladder. DAC characteristics &specifications. DAC errors. ADC: Successive-approximation, Dual-slope, Delta-sigma, ADC codes and errors.		
MODULE 10:	**Waveform display devices & applications**	**4 Hours**
CRT, LCD, LED. PLL and its applications.		
MODULE 11:	**Introduction to controllers**	**4 Hours**
Basic concepts. Torque measurement using magneto strictive sensing		
MODULE 12:	**Controller implementation**	**4 Hours**
Electronic analog P, PI, PD, PID controllers. Pneumatic controllers: baffle-nozzle amplifiers, relay valve, pneumatic P, PI, PD, PID controllers		
TOTAL LECTURES		**46 Hours**

Text Books:

1. Doeblin. "Measurement Systems-Application and Design", McGraw Hill Education, 2017.
2. Neubert , "Instrument Transducers", Oxford University Press.
3. Patranabis, "Sensors and Transducers", Prentice Hall India Learning Pvt. Ltd.
4. D. Patranabis, "Principle of Industrial Instrumentation", McGraw Hill Education, 2017.
5. D. Patranabis, "Principle of Electronic Instrumentation", Prentice Hall India Learning Pvt. Ltd., 2008.
6. W. K. Chen, "Passive and Active Filters: Theory and Implementations", Wiley India Pvt. Ltd., 2003.
7. S. Bhanot, "Process Control", Oxford University Press, 2007.
8. S. K. Singh, "Process Control: Concepts, Dynamics and Applications", PHI, 2007.

Reference

NPTEL Lectures of IIT Kharagpur

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
CO-2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
CO-3	3	-	2	2	-	-	-	-	-	-	-	-	2	3	2
CO-4	3	2	-	-	-	-	-	-	-	-	-	-	2	3	2
CO-5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
CO-6	3	-	3	3	2	-	-	-	-	-	-	-	3	3	3
	3.0	2.0	2.5	2.5	2.0	-	-	-	-	-	-	-	2.7	3.0	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 6th Sem
Course Title: Data Structure and Algorithms	**Subject Code:** TIU-UEE-E316
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. To implement and utilize various standard data structures using C and Java.
2. To implement different searching and sorting algorithms.

3. To apply the understandings to solve real-life problems.
4. Develop efficient data structures for any given scenario.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To understand about the fundamental data types and structures used in different programming environments	K2
CO-2:	To construct and make use of behaviours of arrays, linked-lists, stacks, queues, trees, etc.	K4
CO-3:	To realize discrete structures, such as, sets, graphs, etc.	K4
CO-4:	To analyse algorithms and compute their complexities	K2
CO-5:	To implement search algorithms on graphs	K4
CO-6:	To understand the behaviours of programs	K6

COURSE CONTENT:

MODULE 1:	**Introduction to Algorithm Design and Data Structures**	**6 Hours**
Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures. Design and Analysis of Algorithm: Algorithm Definition, Comparison of Algorithms, Top-Down and Bottom-Up Approaches to Algorithm Design, Analysis of Algorithm, Complexity Measures in Terms of Time and Space, Structured Approach to Programming.		
MODULE 2:	**Arrays**	**6 Hours**
Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays; Application of Arrays Matrix Multiplication, Sparse Polynomial Representation and Addition.		
MODULE 3:	**Stacks and Queues**	**6 Hours**
Representation of Stacks and Queues, Using Arrays and Linked-List; Circular Queues Priority Queue and D-Queue; Applications of Stacks, Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks.		
MODULE 4:	**Linked Lists**	**6 Hours**
Singly Linked List, Operations on List, Linked Stacks and Queues, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists, Generalized List Structure, Sparse Matrix Representation Using Generalized List Structure.		

MODULE 5:	**Trees**	**9 Hours**
Binary Tree Traversal Methods, Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Algorithms for Above Mentioned Traversal Methods; Representation of Trees and Its Applications Binary Tree Representation of a Tree, Conversion of Forest into Tree, Threaded Binary Trees, Lexical Binary Trees, Decision and Game Trees, Binary Search Tree: Height Balanced (AVL) Tree, B-Trees, B+ Tree.		
MODULE 6:	**Searching, Sorting and Complexity**	**8 Hours**
Searching: Sequential and Binary Searches, Indexed Search, Hashing Schemes. Sorting: Insertion, Selection, Bubble, Quick, Merge, Radix, Shell, Heap Sort. Comparison of Time Complexity.		
MODULE7:	**Graphs**	**4 Hours**
Graph Representation, Adjacency Matrix, Adjacency Lists, Traversal Schemes, Depth First Search and Breadth First Search.		
TOTAL LECTURES		**45 Hours**

Books:

1. Horowitz and Sahani, Data Structure using C,
2. Lipshutz, Data Structures with C, Mc-Graw Hill.
3. Supplementary Reading:
4. Robert Lafore, Data Structures and Algorithms In Java, Sams.
5. A.M. Tennenbaum, Y. Langsam and M. J. Augenstein, Data Structures Using C, PHI, 1996.
6. Donald Knuth, The Art of Computer Programming-Vol-I & Vol-II, Narosa Publication.

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
CO-2	3	-	2	2	-	-	-	-	-	-	-	-	3	3	2
CO-3	3	-	2	2	-	-	-	-	-	-	-	-	2	3	2
CO-4	3	2	-	2	-	-	-	-	-	-	-	-	3	3	2
CO-5	3	-	2	2	-	-	-	-	-	-	-	-	2	3	3
CO-6	3	-	3	3	2	-	-	-	-	-	-	-	3	3	3

	3.0	2.0	2.3	2.2	2.0	-	-	-	-	-	-	-	2.7	3.0	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Digital Signal Processing Lab	**Subject Code:** TIU-UEE-L308
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. To develop programs for processing discrete-time signals and linear discrete-time systems, ensuring an understanding of BIBO stability and system responses.
2. To implement fundamental signal processing techniques, including convolution, Fourier transforms, and filtering, using MATLAB.
3. To design and analyse FIR and IIR filters for various applications, considering aliasing effects and system stability.

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COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-7:	To analyse the transients produced by circuit-breaker operation and to understand working of different types of switchgear.	K4
CO-1	Understand and implement discrete-time signals, systems, and their properties.	K1
CO-2	Develop and analyse programs for convolution operations on discrete signals.	K2
CO-3	Compute DTFT and DFT using different methodologies.	K3
CO-4	Implement and analyse linear filtering using the DFT-IDFT method.	K3
CO-5	Design and simulate FIR and IIR filters using MATLAB.	K4
CO-6	Analyse system functions, poles, and zeros for system stability.	K4

COURSE CONTENT:

MODULE 1:	Time domain and frequency domain analysis	**09 Hours**
Study discrete-time signals as finite sequences to analyze BIBO stability and evaluation of different systems' aliased or non-analyzed output responses by different convolution techniques in time domain, frequency domain.		
MODULE 2:	z-transform techniques	**09 hours**
Study z-transform techniques of LTI DTS FIR systems and IIR systems for convolution to get aliased or non-aliased output responses and determine poles, zeros, and stability.		
MODULE 3:	FIR filters	**12 hours**
Design and implementation of various FIR filters using different windowing techniques, comparison of filter characteristics		
MODULE 4:	IIR filters	**12 hours**
Design and implementation of various IIR filters using Butterworth and Chebyshev-Type I methods		
TOTAL LAB HOURS		**42 hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	-	-	-	-	-	-	-	-	2	3	2
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2
CO-3	3	-	2	2	-	-	-	-	-	-	-	-	2	3	2
CO-4	3	-	3	2	-	-	-	-	-	-	-	-	3	3	2
CO-5	3	-	3	3	2	-	-	-	-	-	-	-	3	3	3
CO-6	3	-	2	3	-	-	-	-	-	-	-	-	3	3	3
	3.0	2.5	2.4	2.5	2.0	-	-	-	-	-	-	-	2.5	3.0	2.3

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Power Electronics Lab	**Subject Code:** TIU-UEE-L310
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Provide students with practical exposure to various power electronic components, including diodes, thyristors, MOSFETs, and IGBTs, enhancing their understanding of device characteristics and operational principles.
2. Enable students to design, implement, and analyse circuits such as controlled rectifiers, inverters, and DC-DC converters fostering a deep understanding of their functionality and performance metrics.
3. Equip students with skills to use simulation software for modelling and analysing power electronic circuits, promoting efficient design processes and problem-solving abilities.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To describe the operation of various Power Electronic devices and its applications.	K2

CO-2	To analyse the I-V characteristics of SCR, DIAC, TRIAC, etc.	K4
CO-3	To understand and analyse the functioning of firing circuits.	K4
CO-4	Employ simulation software to model and analyse power electronic circuits, facilitating design optimization and understanding of circuit behaviour before physical implementation.	K4
CO-5	To illustrate the functioning of controlled rectifiers with various types of loads	K4
CO-6	To understand the operation and performance of DC- DC converters.	K2

COURSE CONTENT:

MODULE 1:	Power Semiconductor Devices	**6 Hours**
Study of Power Semiconductor Devices, Understand the V-I characteristics of SCR, Studying and understanding of the influence of gate triggering on the conduction and blocking regions of the SCR		
MODULE 2:	Controlled Rectifiers	**18 Hours**
Understand the working principles of a single-phase half-wave controlled rectifier, Ability to analyze the output voltage and current characteristics under resistive and RC load conditions, Understand the operation of a single-phase fully controlled bridge rectifier, Ability to analyze the behavior of the rectifier with different load types (R, R-L, R-L-E)		
MODULE 3:	TRIAC and Converter Circuits	**12 Hours**
Learn to plot and interpret the V-I characteristics of a TRIAC, Understanding the impact of gate current on the TRIAC's conduction behavior, Understand and Analyze the working principle and circuit operation of Boost and Buck Converter		
MODULE 4:	Inverters	**6 Hours**
Understand the role of Voltage Source Inverters (VSIs) in converting DC to AC power, Evaluate the efficiency, voltage regulation and Harmonic Distortion in Half-Bridge Inverters		

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TOTAL LAB HOURS:	**42 Hours**

Books:

1. Laboratory Manuals
2. Power Electronics: Rashid
3. Power Electronics: Khanchandani

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	-	-	-	-	-	-	-	-	2	3	2
CO-2	3	3	2	-	-	-	-	-	-	-	-	-	2	3	2
CO-3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	2
CO-4	3	-	3	2	3	-	-	-	-	-	-	-	3	3	3
CO-5	3	-	3	2	-	-	-	-	-	-	-	-	3	3	3
CO-6	3	2	2	-	-	-	-	-	-	-	-	-	2	3	2
	3.0	2.5	2.6	2.0	3.0	-	-	-	-	-	-	-	2.5	3.0	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester: 3rd** Yr., 6th Sem
Course Title: Electrical Power Systems-II Lab	**Subject Code:** TIU-UEE-L314
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. To provide students with a solid understanding of the concepts and principles behind power system protection, including fault detection, isolation, and system reliability.
2. To introduce students to relay coordination and time-current characteristics to ensure effective protection with minimal system disruption during faults.
3. To use simulation software (such as MATLAB, SCILAB, PSCAD) to simulate protection system responses to different fault conditions and evaluate their effectiveness.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To understand the necessity and the working principle of different protection schemes and various relaying equipment.	K2
CO-2	To derive and understand the operating characteristics of different types of relays.	K2

CO-3	To understand the operation and synchronization of an alternator to grid.	K2
CO-4	To control the active and reactive power output of an alternator.	K3
CO-5	To analyse the network by calculating the state-variables for different operating conditions and assess the mathematical tools employed in terms of their computational requirements during software implementation.	K4
CO-6	Understand the importance of protection devices in safeguarding both equipment and personnel.	K3

COURSE CONTENT:

MODULE 1:	Protection Schemes	**18 Hours**
Study various relay types (Under-voltage, Over-current, Earth-fault, Microprocessor-based)		
MODULE 2:	Alternator Control	**6Hours**
Study the control of P-Q output and synchronization to grid		
MODULE 3:	Load-Flow Analysis	**18 Hours**
Implement Gauss-Seidel and Newton-Raphson methods using SCILAB		
TOTAL LAB HOURS		**42 Hours**

Books:

1. Laboratory Manuals
2. Power System Engineering: I.J. Nagrath & D.P. Kothari
3. A Course in Power System: J.B. Gupta

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-2	2	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-3	2	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-4	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-5	3	3	3	-	-	-	-	-	-	-	-	-	3	3	-
CO-6	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-
	2.5	2.3	3.0	-	-	-	-	-	-	-	-	-	2.2	3.0	-

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Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Instrumentation and Process Control Lab	**Subject Code:** TIU-UEE-L316B
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Understand the principles and working of various measurement techniques and control systems.
2. Apply measurement and simulation techniques using tools like SCILAB and PSIM.
3. Develop ladder logic programs for automation applications such as motor control and traffic light systems.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Understand and apply principles of flow, pressure, and temperature measurement	K2
CO-2	Identify suitable sensors/transducers for process variable measurement	K3
CO-3	Analyze and apply bridge circuits for accurate measurement of electrical parameters	K4
CO-4	Simulate and analyze process control systems using SCILAB	K4
CO-5	Evaluate the impact of controller tuning on system performance	K5
CO-6	Design and implement automation solutions using PLC programming	K6

COURSE CONTENT:

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MODULE 1:	Transducers and Sensors	**12 Hours**
Understand the working principle of a Pitot tube and its application- Analyze the velocity profile and pressure variations-Demonstrate the working principle of a piezoelectric transducer and its applications- Principle of Temperature Measurement- Types of Temperature Sensors-Error sources, and compensation methods.		
MODULE 2:	Unknown Capacitance Measurement	**3 Hours**
Understand the working principle of a Schering bridge for capacitance measurement-Mathematical formulation-Dissipation factor- Analyze the effect of dielectric loss on capacitance measurements.		
MODULE 3:	Process Control using Simulation Tools	**12 Hours**
Implement P, PI and PID controllers in SCILAB- Analyze the transient and steady-state response of a first-order and second order system- Compare the effectiveness of P, PI and PID controllers in improving system performance-Analyze system stability and performance.		
MODULE 4:	PLC Programming and Automation	**15 Hours**
Understand the fundamentals of logic gates and their implementation in PLCs- Develop ladder logic programs and its simulation-Understand the working principles of timers and counters in PLC programming- Develop ladder logic diagrams incorporating timers and counters for motor control, sequential traffic light system- Practical applications.		
TOTAL LAB HOURS		**42 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-2	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-
CO-3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	-
CO-4	3	-	3	2	-	-	-	-	-	-	-	-	3	3	-
CO-5	3	2	3	-	-	-	-	-	-	-	-	-	3	3	-
CO-6	3	-	3	3	2	-	-	-	-	-	-	-	3	3	-
	2.8	2.3	3.0	2.5	2.0	-	-	-	-	-	-	-	2.7	3.0	-

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: Data Structure and Algorithms Lab	**Subject Code:** TIU-UEE-L316
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. To develop a strong foundation in data structures and their real-world applications through hands-on implementation.
2. To design and analyse algorithms to solve computational problems efficiently using C and Java.
3. To compare and contrast different data structures and algorithmic techniques for optimizing performance.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Implement and manipulate various linear and non-linear data structures in C and Java.	K1
CO-2	Design and develop searching and sorting algorithms and analyse their complexities	K2
CO-3	Develop efficient spellchecking techniques using binary search and hashing methods.	K3
CO-4	Apply data structures like linked lists, trees, and hash tables to solve computational problems.	K3
CO-5	Compare sorting algorithms based on time and space complexity.	K3
CO-6	Analyse and evaluate different algorithmic techniques for solving real-world problems.	K4

COURSE CONTENT:

Module 1:	**Linked Lists & Memory Management**	**9 Hours**

Implementation of singly linked lists - Insertion, deletion, and traversal operations - Memory management and dynamic allocation in linked lists.		
Module 2:	**Searching**	**9 Hours**
Implementation of binary search algorithm - Dictionary-based word lookup for spellchecking - Performance analysis of binary search.		
Module 3:	**Sorting & Complexity**	**9 Hours**
Implementing a spellchecking algorithm using Java - Using HashSet and TreeSet for efficient lookup - Comparison with binary search-based approach.		
Module 4:	**Hashing & Expression Evaluation**	**6 Hours**
Implementing and comparing Bubble Sort, Insertion Sort, Quick Sort, and Merge Sort - Analyzing time complexity - Evaluating the best, worst, and average cases.		
Module 5:	**Trees & Recursive Structures**	**9 Hours**
Implementing hash table using open addressing and chaining - Hash functions and collision resolution techniques -Performance comparison of different hashing techniques.		
TOTAL LAB CLASSES:		**42 Hours**

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	2	3	-	3	-	-	-	-	-	-	-	2	3	2
CO-2	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
CO-3	3	2	3	-	3	-	-	-	-	-	-	-	3	3	3
CO-4	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
CO-5	3	2	3	-	3	-	-	-	-	-	-	-	3	3	3
CO-6	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3
	2.8	2.5	3.0	2.0	3.0	-	-	-	-	-	-	-	2.8	3.0	2.8

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: CASD: AUTOCAD: Electrical Application	**Subject Code:** TIU-UEE-S302A
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. To recapitulate key concepts and familiarize students with the basics of AutoCAD and its applications in electrical design.
2. To practice 2D sketches of electrical components and layouts using AutoCAD tools.
3. To enable students to design electrical wiring layouts and circuits for residential and industrial applications.
4. To introduce students to the design of electrical symbols and substation layouts using AutoCAD for power system applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Demonstrate an understanding of AutoCAD fundamentals and user interface.	K2
CO-2	Develop 2D sketches of electrical components and layouts using AutoCAD.	K3
CO-3	Design and implement electrical wiring layouts for residential and industrial applications.	K4
CO-4	Create electrical symbols, motor control circuits, and substation single-line diagrams using AutoCAD.	K4
CO-5	Apply drawing and editing commands to create simple electrical schematics and control circuits.	K3
CO-6	Develop and interpret electrical ladder diagrams, panel layouts, and wiring diagrams using AutoCAD Electrical tools.	K6

COURSE CONTENT:

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MODULE 1:	**Basics of AutoCAD**	**4 Hours**
Recapitulate various drawing tools of AutoCAD-Application in electrical design		
MODULE 2:	**2D SKETCH OF PRACTICE MODEL-1 MODEL-2**	**4 Hours**
Practice and reinforce 2D sketching skills in AutoCAD specify its dimensions-Familiarize with basic drawing tools and commands.		
MODULE 3:	**Wiring of a flat using commercially available AutoCAD software**	**4 Hours**
Design the wiring layout of a flat		
MODULE 4:	**Design of Electrical Symbols Using AutoCAD**	**6 Hours**
Draw standard electrical symbols using AutoCAD for circuit diagrams and electrical schematics		
MODULE 5:	**Design of Electrical Motor Control Circuit Using AutoCAD**	**4 Hours**
Design an electrical motor control circuit-Residential and industrial application		
MODULE 6:	**33kV/11kV Substation Single Line Diagram Design using AutoCAD**	**10 Hours**
Understand the design of a 33kV/11kV substation single-line diagram-Drafting substation layout		
TOTAL LAB HOURS:		**32 Hours**

Books:

1. Laboratory Manuals
2. Handbook of Electrical Design, Neil Sclater, John E. Traister

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	-	3	-	-	-	-	-	-	-	2	3	3
CO-2	2	2	2	-	2	-	-	-	-	-	-	-	2	2	2
CO-3	2	2	2	-	2	-	-	-	-	-	-	-	2	2	2
CO-4	3	2	3	-	3	-	-	-	-	-	-	-	2	3	3
CO-5	3	2	3	-	3	-	-	-	-	-	-	-	2	3	3
CO-6	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
	2.7	2.2	2.7	-	2.7	-	-	-	-	-	-	-	2.2	2.7	2.7

Department of Electrical Engineering

Program: B. Tech. in EE (BEE)	**Year, Semester:** 3rd Yr., 6th Sem
Course Title: CASD: MATLAB Programming & Simulation	**Subject Code:** TIU-UEE-S302B
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 1**

COURSE OBJECTIVE:

Enable the student to:

1. To introduce students to MATLAB and its fundamental concepts for numerical computing and simulation.
2. To develop problem-solving skills using MATLAB for electrical engineering applications.
3. To enable students to analyze, visualize, and interpret data using MATLAB tools.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Explain the basic MATLAB environment and its functions	K2
CO-2	Use MATLAB for performing basic mathematical computations	K3
CO-3	Implement matrix operations and vector manipulations in MATLAB	K4
CO-4	Develop simple MATLAB scripts and functions for automation	K4
CO-5	Apply MATLAB to solve electrical circuit analysis problems	K4
CO-6	Visualize and analyse data using MATLAB's plotting tools	K4

COURSE CONTENT:

MODULE 1:	**Introduction to MATLAB**	**4 Hours**
Overview of MATLAB environment, command window, script files - Basic operations: arithmetic, variables, and data types		
MODULE 2:	**Matrix and Vector Operations**	**4 Hours**
Creation and manipulation of matrices and vectors - Basic linear algebra operations – various matrix operation related to electrical engineering		
MODULE 3:	**MATLAB Functions and Control Statements**	**4 Hours**

Writing and using functions - If-else, loops (for, while) – implementing small program related to subject specific applications.		
MODULE 4:	**Data Visualization and Plotting**	**4 Hours**
2D and 3D plotting techniques - Customizing plots with labels, legends, and colour – visualize different signal representation – image edits: editing x-y ranges – editing brightness – picture resolution		
MODULE 5:	**Signal Processing with MATLAB**	**8 Hours**
Basics of signal generation and processing - Applying filters and Fourier Transform – measuring frequency – applying different wavelet transform related to power system applications.		
MODULE 6:	**Electrical Circuit Simulation using MATLAB**	**8 Hours**
Solving circuit equations using MATLAB - Simulating simple electrical systems – creating basic circuits in MATLAB Simulink – changing different parameters – creating different power electronics circuits – Run the Simulink and taking different parameters values.		
TOTAL LAB HOURS:		**32 Hours**

Books:

1. Laboratory Manuals

2. Getting Started with MATLAB" – Rudra Pratap

3. "MATLAB and Simulink for Engineers" – Agam Kumar Tyagi

4. "MATLAB-Based Electrical Machines and Power Systems Analysis" – Hemchandra Madhusudan Shertukde

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO-3	2	2	2	-	2	-	-	-	-	-	-	-	2	2	2
CO-4	3	2	3	-	3	-	-	-	-	-	-	-	2	3	3
CO-5	3	2	3	-	3	-	-	-	-	-	-	-	2	3	3
CO-6	3	3	3	-	3	-	-	-	-	-	-	-	3	3	3
	2.7	2.2	2.7	-	2.7	-	-	-	-	-	-	-	2.2	2.7	2.7

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SEMESTER 7

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Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Electric Drives	**Subject Code:** TIU-UEE-T413
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Classify electrical drives, and justify multi-quadrant operation of drives along with load equalization.
2. Analyse the dynamics of the drive for different duty cycles considering the effect of load inertia and environmental factors.
3. Analyse different starting and braking methods of electric motors.
4. Analysis of performance of DC motors with load.
5. Appraise the speed and frequency control method of Induction motor and synchronous motor.
6. Identify suitable form of electrical drives system in Industry.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To understand the basic electrical drives, and justify multi-quadrant operation of drives along with load equalization.	K2
CO-2:	To Analyse the dynamics of the drive for different duty cycles considering the effect of load inertia and environmental factors.	K4
CO-3:	To analyse different starting and braking methods of electric motors	K4
CO-4:	To understand the of performance of DC motors with load.	K2
CO-5:	To analyse the speed and frequency control method of Induction motor and synchronous motor.	K4
CO-6:	To create new type of electrical drives system in Industry	K6

COURSE CONTENT:

MODULE 1:	**Electric Drive fundamentals**	**6 Hours**
Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi		

quadrant operation of drives. Load equalization.		
MODULE 2:	**Motor power rating**	**6 Hours**
Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.		
MODULE 3:	**Stating of Electric Drives and Braking of Electric Drives**	**6 Hours**
Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time Energy relation during stating, methods to reduce the Energy loss during starting. Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.		
MODULE 4:	**DC motor drives**	**6 Hours**
Modelling of DC motors, State space modelling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current chopper-controlled DC motor drives.		
MODULE 5:	**Induction motor drives**	**6 Hours**
Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.		
MODULE 6:	**Synchronous motor drives**	**6 Hours**
Variable frequency control, Self-Control, Voltage source inverter fed synchronous motor drive, Vector control.		
MODULE7:	**Industrial application**	**4 Hours**
Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive. Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.		
TOTAL LECTURES		**40 Hours**

Books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH.
3. A first course on Electrical Drives, S.K. Pillai, New Age International Publication.

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CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
CO-2	3	2	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-3	3	-	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-4	2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
CO-5	3	-	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-6	3	-	3	-	3	-	-	-	-	-	-	-	-	3	3
	2.7	2.0	3.0	2.0	3.0	-	-	-	-	-	-	-	-	3.0	3.0

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Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Power Systems-III	**Subject Code:** TIU-UEE-T415
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. understand the causes, nature and steps for reduction of transients.
2. understand the requirement of automatic generation control for a single area and two-area systems to maintain the system frequency and the necessity and methods to maintain the voltage profile in a power network.
3. understand the problem of minimization of operating cost with and without considering transmission losses.
4. develop in students an ability and skill to design analytical tools for monitoring and control of a power system

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To analyze methods to control the frequency and power flow.	K4
CO-2:	To understand methods to control the voltage.	K2
CO-3:	To understand the concepts of monitoring and control of a power system and solve state estimation problems.	K3
CO-4:	To understand the basics of power system economics and scheduling.	K2
CO-5:	To solve scheduling problems.	K3
CO-6:	To understand the concepts of power system transients.	K2

COURSE CONTENT:

MODULE 1:	**CONTROL OF FREQUENCY AND VOLTAGE**	**18 Hours**
Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers. Power flow control using embedded dc links, phase shifters. Reactive Power Sensitivity and Voltage Control; Load Compensation with Capacitor Banks; Line Compensation with Reactors; Shunt and Series Compensation; Fixed Series Capacitors; Thyristor Controlled Series Capacitors;		
MODULE 2:	**MONITORING AND CONTROL**	**6 Hours**
Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency,		

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Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.		
MODULE 3:	**POWER SYSTEM ECONOMICS AND MANAGEMENT**	**16 Hours**
Basic Pricing Principles: Generator Cost Curves, Economic Operation of Thermal System; Plant Scheduling; Transmission Loss and Penalty Factor; Hydro-Thermal Scheduling; Concept of Reserves and Constraints; Unit Commitment; Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.		
MODULE 4:	**POWER SYSTEM TRANSIENTS**	**8 Hours**
Types of System Transients; Overvoltage in Transmission Lines; Propagation of Surges and Travelling Waves; Protection against Lightning and Surges;		
TOTAL LECTURES		**48 Hours**

Books:

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
4. Wood and Wollenberg, "Electric Power generation, operation and control", Willey
5. P. Kundur, "Power System Stability and Control".

References

1. NPTEL course problems of "Power System Analysis" conducted by IIT Kharagpur

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	-	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-2	2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
CO-3	3	2	3	3	-	-	-	-	-	-	-	-	-	3	3
CO-4	2	-	3	2	-	-	-	-	-	-	-	-	-	3	2
CO-5	3	-	3	2	-	-	-	-	-	-	-	-	-	3	2
CO-6	2	-	3	2	-	-	-	-	-	-	-	-	-	3	3
	2.5	2.0	3.0	2.2	-	-	-	-	-	-	-	-	-	3.0	2.7

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Utilization of Electric power	**Subject Code:** TIU-UEE-T417

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Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Understand the basics of lighting and illumination and its parameters.
2. To study the basic principles of illumination and its measurement.
3. To acquaint with the different types of heating and welding techniques.
4. To understand the basic principle of electric traction including speed–time curves of different traction services.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the systems of traction electrification, analyze train movement and energy consumption, and identify factors affecting energy use.	K3
CO-2:	Analyze the operation, starting, and braking methods of electric traction motors and understand their control including linear induction motors.	K4
CO-3:	Understand and apply the basic principles and laws of illumination, including different types of lamps and lighting design methods.	K2
CO-4:	Analyze various electric heating methods like resistance, induction, dielectric, and microwave heating for industrial applications.	K4
CO-5:	Understand different welding methods such as resistance, arc, ultrasonic, electron beam, and laser welding, including their power supply needs.	K2
CO-6:	Understand protective devices and the impact of electric traction on telecommunication circuits.	K2

COURSE CONTENT:

MODULE 1:	**Traction**	**10 Hours**
System of Traction Electrification, Train movement & energy consumption (Speed-time curves, Crest speed, Average speed & Schedule speed), Tractive effort, Factors affecting energy consumption (Dead weight, Acceleration weight & Adhesion weight), Protective devices.		
MODULE 2:	**Electric Traction motor & their control**	**10 Hours**
Starting, braking with special emphasis on power electronic controllers, Current collector, Interference with telecommunication circuit. A brief outline of linear Induction motor principle in Traction.		
MODULE 3:	**Illumination**	**10 Hours**
Laws of illumination, Polar cuvees, Photometry, Integrating sphere, Types of Lamps: Conventional and Energy Efficient, Basic principle of Light control, Different lighting scheme & their design methods, Flood and Street lighting.		
MODULE 4:	**Heating**	**6 Hours**

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Types of heating, Resistance heating, Induction heating, Arc furnace, Dielectric heating, Microwave heating		
MODULE 5:	**Welding**	**6 Hours**
Resistance welding, Arc welding, Ultrasonic welding, Electron bean welding, Laser beam welding, Requirement for good welding, Power supplies for different welding schemes.		
TOTAL LECTURES		**42 Hours**

Books:

1. Utilization of Electric Energy: Taylor.
2. Art & Science of Utilization of Electrical Energy: Partab
3. Modern Utilization of Electric Power Including Electric Drives and Electric Traction: Pradip Kumar Sadhu, Soumya Das.

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	2	-	-	-	-	-	-	-	-	2	3	2
CO-2	3	2	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-3	3	2	3	-	-	-	-	-	-	-	-	-	2	3	2
CO-4	3	-	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-5	3	-	3	2	-	-	-	-	-	-	-	-	-	3	3
CO-6	3	-	2	2	-	-	-	-	-	-	-	-	-	3	2
	3.0	2.0	2.8	2.0	-	-	-	-	-	-	-	-	2.0	3.0	2.5

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Special Electrical Machines	**Subject Code:** TIU-UEE-E411A
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

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Enable the student to:

1. To understand the theoretical basis for calculating electric fields in various situations.
2. To understand the theoretical basis for calculating magnetic fields in various situations.
3. To understand the propagation of electromagnetic waves.
4. To develop theoretical concepts of electromechanical devices used in industry.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	Explain the constructional features, principle of operation, and special characteristics of stepper motors, including variable reluctance and permanent magnet stepper motors.	K2
CO-2	Describe the construction, working principle, torque equation, characteristics, control techniques, and drive concepts of switched reluctance motors.	K3
CO-3	Differentiate between mechanical and electronic commutation in DC motors, derive torque and EMF equations, and analyse rotor position sensors in multiphase brushless DC motors.	K4
CO-4	Examine the principles of operation, EMF, power input, torque expressions, phasor diagrams, power controllers, and torque-speed characteristics of permanent magnet synchronous motors.	K4
CO-5	Illustrate the construction, operation, types, and characteristics of servomotors, tacho generators, synchro's, resolvers, and linear induction motors.	K4
CO-6	Analyse and evaluate the principles, modelling, and power management of electric vehicles, including foundational concepts and their industrial applications.	K4

COURSE CONTENT:

MODULE 1:	**STEPPER MOTORS**	**6 Hours**
Stepper motor Constructional features, Principle of operation, Special features of stepper motors, Variable reluctance, Permanent magnet stepping motor, Torque versus stepping rate Characteristics.		
MODULE 2:	**SWITCHED RELUCTANCE MOTORS**	**6 Hours**
Switched Reluctance Motor Constructional features, Principle of operation, Torque equation, Characteristics, Control Techniques, and Drive Concept.		
MODULE 3:	**PERMANENT MAGNET BRUSHLESS DC MOTORS**	**8 Hours**
Commutation in DC motors, Difference between mechanical- and electronic-commutators, Torque and EMF equation, Rotor position sensors, Multiphase Brushless DC motor, square wave permanent magnet brushless DC motor drives and their torque-speed characteristics.		
MODULE 4:	**PERMANENT MAGNET SYNCHRONOUS MOTORS**	**6 Hours**
Principle of operation, EMF, Power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics.		

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MODULE 5:	**SERVO MOTORS**	**6 Hours**
Servomotor, Constructional features, Principle of Operation, Types, Characteristics, Control Tacho generators, Synchro's & resolvers, Linear Induction motor.		
MODULE 6:	**ELECTRIC VEHICLE**	**8 Hours**
Introduction to Electric Vehicles, Electric Vehicle Foundations, Understanding the Foundations, Mathematical Modelling of an electric vehicle, Power management of EV		
TOTAL LECTURES		**40 Hours**

Books:

1. Electrical Machinery, P.S. Bhimra, Khanna Publishers.
2. Electrical Machines, Nagrath & Kothary, TMH
3. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	-	-	-	-	-	-	-	-	-	2	3	2
CO-2	3	2	2	-	-	-	-	-	-	-	-	-	2	3	2
CO-3	3	2	3	2	-	-	-	-	-	-	-	-	2	3	2
CO-4	3	2	3	2	-	-	-	-	-	-	-	-	2	3	3
CO-5	3	2	3	-	-	-	-	-	-	-	-	-	2	3	2
CO-6	3	2	3	2	-	-	-	-	-	-	-	-	3	3	3
	3.0	2.0	2.7	2.0	-	-	-	-	-	-	-	-	2.2	3.0	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Web Technologies	**Subject Code:** TIU-UEE-E411B
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. To implement and utilize various standard data structures using C and Java.

2. To implement different searching and sorting algorithms.
3. To apply the understandings to solve real-life problems.
4. Develop efficient data structures for any given scenario.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Explain fundamental web technologies, including protocols, servers, network security, and internet development concepts.	K2
CO-2:	Apply HTML, CSS, and JavaScript to design and develop responsive and interactive web pages.	K3
CO-3:	Analyse the role of the Document Object Model (DOM) and jQuery in dynamic web development.	K4
CO-4:	Demonstrate database management skills using SQL and MySQL, including database creation, querying, and user access control.	K3
CO-5:	Evaluate different backend technologies and frameworks such as Node.js, AngularJS, and React for web application development.	K5
CO-6:	Design a fully functional web application by integrating frontend, backend, and database technologies.	K6

COURSE CONTENT:

MODULE 1:	**Web Fundamentals and HTML**	**7 Hours**
Web protocols (HTTP, HTTPS), servers & clients, IP, DNS, hosting basics, network security, SSL, domain names. HTML tags & structure, headings, paragraphs, lists, images, links, tables, forms, semantic markup, accessibility.		
MODULE 2:	**CSS and Responsive Design**	**7 Hours**
CSS syntax, selectors (ID, class, element), box model, layout techniques (Flexbox, Grid), media queries, responsive design, positioning, z-index, transitions, animations, UI styling best practices.		
MODULE 3:	**JavaScript and DOM**	**9 Hours**
JS variables, data types, operators, control structures, arrays, functions, DOM manipulation (selectors, content update, styling), event handling, form validation, scope, closures, callbacks.		
MODULE 4:	**jQuery and Advanced JavaScript**	**6 Hours**
jQuery syntax, DOM selectors, event handling, chaining, animations (fade, slide), AJAX calls, handling JSON, localStorage/sessionStorage usage.		
MODULE 5:	**SQL and MySQL**	**8 Hours**
Database creation, table design, keys, CRUD operations, joins, aggregations, user management, access		

control, SQL best practices, ER diagrams, relational design, data security.		
MODULE 6:	**Backend & Full Stack Integration**	**8 Hours**
Backend: Node.js, Express.js, REST APIs, routes, middleware. Frontend: React basics (JSX, components, props, state). Database connectivity. Project deployment (Heroku, Netlify). Full stack project integrating frontend, backend, and DB.		
TOTAL LECTURES		**45 Hours**

Books:

1. Laura Lemay, MASTERING HTML, CSS & Java Script Web Publishing
2. Sibastian Springer, Node.js: The Comprehensive Guide
3. Abraham Silberschatz, Henry F. Korth, Database System Concepts

CO-PO-PSO MAPPING:

CO / PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	-	-	-	2	-	-	-	-	-	-	2	3	2
CO-2	2	3	3	-	2	-	-	-	-	-	-	-	2	3	3
CO-3	2	2	3	2	-	-	-	-	-	-	-	-	2	3	3
CO-4	2	2	3	-	-	-	-	-	-	-	-	-	2	2	3
CO-5	2	2	3	3	-	-	-	-	-	-	-	-	2	3	3
CO-6	3	2	3	3	2	-	-	-	-	-	-	-	3	3	3
	2.3	2.2	3.0	2.7	2.0	2.0	-	-	-	-	-	-	2.2	2.8	2.8

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Electric Drives Lab	**Subject Code:** TIU-UEE-L413
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit: 1.5**

COURSE OBJECTIVE:

Enable the student to:

1. To provide students with a solid understanding of electrical drive systems, including DC and AC motors, their operation and control methods.

2. To enable students to understand and analyse various drive parameters like speed, torque, efficiency and power factor.
3. To expose students to real-world applications of electrical drives in industries such as robotics, automation, electric vehicles and industrial machinery and analyse the performance and selection criteria for different drive systems based on specific applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To understand the fundamentals of electrical drives.	K2
CO-2	To analyse the dynamics of the drive for different duty cycles.	K4
CO-3	To analyse different starting methods of electric motors.	K4
CO-4	To understand the speed control methods of single-phase Induction motors.	K2
CO-5	To analyse the speed and frequency control method of three phase Induction motors.	K4
CO-6	To create and apply new type of electrical drives system in Industry.	K3

COURSE CONTENT:

MODULE 1:	Inverters	**12 Hours**
Single-Phase Full Bridge Inverter and Sine Wave PWM Inverter		
MODULE 2:	Single-Phase Drives	**6Hours**
Speed Control of Single-Phase Induction Motor		
MODULE 3:	Three-Phase Drive Start-up	**6 Hours**
Starting and running of a Three Phase Induction Motor using Single Phase Supply		
MODULE 4:	DC Motor Drive	**6 Hours**
Four Quadrant Chopper Controlled DC Motor Drive		
MODULE 5:	Variable Frequency Drives	**12 Hours**
Speed control of 3-Phase Induction Motor using VVVF and IGBT based Sine Wave Inverter		
TOTAL LAB HOURS		**42 Hours**

Books:

1. Laboratory Manuals
2. Electric Drives: N.K. De, P.K. Sen
3. Electrical Drives by G.K. Dubey

CO-PO-PSO MAPPING:

CO / PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

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CO-1	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-2	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2
CO-3	3	2	-	-	-	-	-	-	-	-	-	-	3	2	2
CO-4	2	-	-	-	-	-	-	-	-	-	-	-	2	2	2
CO-5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	2
CO-6	3	-	3	2	-	-	-	-	-	-	-	-	3	3	3
	2.7	2.3	3.0	2.0	-	-	-	-	-	-	-	-	2.7	2.5	2.2

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Career Advancement and Skill Development (Digital IC Design & HVDC)	**Subject Code:** TIU-UEE-S401
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. MOS transistors, Switching characteristics of nFET and pFET transistors.
2. CMOS based different Static logic gates, Multiplexers, Adder, Latch circuits, SRAM cell, Tristate digital circuits etc.
3. Pseudo-nMOS and TG logic-based logic circuits.
4. Electrical and Electronic analysis of CMOS logic Gates.
5. HVDC transmission, HVDC converter circuits and their Control modes.

6. Protection against commutation failures of HVDC converters, Harmonics of HVDC converters.
7. Different FACTS devices, their operations and applications.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Physics of MOS transistors, Switching characteristics of nFET and pFET transistors, CMOS implementation of different Static logic gates, Multiplexers, Adder, SR-latch, D-latch, CMOS SRAM cell, Tristate output circuits etc.	K3
CO-2:	Pseudo-nMOS based and TG logic based various logic gates like Inverter gate, NOR gate, NAND gate, XNOR gate etc.	K2
CO-3:	Electrical and Electronic Characteristics of CMOS logic gates	K3
CO-4:	HVDC transmission, HVDC converter circuits and their Control modes, Protection against commutation failures of HVDC converters, Harmonics of HVDC converters	K4
CO-5:	Various FACTS devices, their operations and applications.	K4
CO-6:	Illustrate the timing and power considerations in digital IC design	K2

COURSE CONTENT:

MODULE 1:	**nMOS and pMOS based digital circuits**	**10 Hours**
Physics of MOS transistors, Switching characteristics of nMOS and pMOS transistors, CMOS implementation of different Static logic gates & CMOS implementation of Multiplexers, Adder, SR latch, D-latch, Tristate output circuits.		
MODULE 2:	**Pseudo-nMOS logic-based gates**	**3 Hours**
Pseudo-nMOS logic-based Inverter gate, NOR gate, NAND gate, XNOR gate etc.		
MODULE 3:	**TG based digital logic circuits**	**8 Hours**
TG based Switch logic gates, TG based MUX, OR, XOR, XNOR gates, ADDER circuit.		
MODULE 4:	**Electrical and Electronic Characteristics of MOS devices**	**8 Hours**
Derivation of threshold voltage, aspect ratio, process transconductance, I-V characteristics, Body bias effect, FET RC model, DC characteristics of CMOS gates, Switching characteristics of logic gates like Inverter, NAND gate, NOR gate etc., Power dissipation.		
MODULE 5:	**HVDC transmission**	**10 Hours**
Types of HVDC transmission, merits and demerits, HVDC converter circuits and their characteristics, Control modes of HVDC transmission, Protection against commutation failures of HVDC inverters, Smoothing reactors, Harmonics of HVDC converters.		
MODULE 6:	**FACTS Devices**	**6 Hours**
FACTS devices Different FACTS devices like SVS, STATCOM, TCSC, SSSC, UPFC etc., their operations and applications.		

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TOTAL LECTURES	45 Hours

Books:

1. John P. Uyemura, "CMOS Logic Circuit Design", Kluwer Academic Publishers
2. Power System stability and control by P. Kundur
3. Understanding FACTS by Narain G. Hingorani
4. Flexible AC transmission systems by Xiao-Ping Zhang, Christian Rehtanz, Bikash Pal.
5. FACTS Controllers in Power Transmission & Distribution by K. R. Padiyar
6. Power System Harmonic Analysis by Jos Arrillaga, Bruce,

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	2	3	-	-	-	1	2	1	2	2	3	3
CO-2	3	2	2	2	3	-	-	-	1	1	-	2	2	3	3
CO-3	3	2	2	2	3	-	-	-	-	1	-	2	2	3	3
CO-4	3	3	3	2	3	2	2	-	-	-	1	2	3	3	3
CO-5	3	3	3	2	3	2	3	-	-	-	1	2	3	3	3
CO-6	3	2	3	2	3	-	2	-	1	1	1	2	2	3	3
	3.0	2.3	2.7	2.0	3.0	2.0	2.3	-	1.0	1.3	1.0	2.0	2.3	3.0	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Electrical Machine Design	**Subject Code:** TIU-UEE-S405
Contact Hours/Week: 2-0-0 (L-T-P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. understand the choices, considerations and objectives in electrical machine design.
2. design machines like transformers, induction machines and DC machines.

COURSE OUTCOME:

On completion of the course, the student will be able to:

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CO-1:	Understand the choices, considerations and objectives in electrical machine design.	K2
CO-2:	Design overall transformer for the desired performance characteristics	K6
CO-3:	Design Stator and rotor of an Induction motor and calculate the various parameters	K6
CO-4:	Design Stator and rotor of a DC machine	K6
CO-5:	Evaluate the performance parameters of electrical machines based on design aspects.	K5
CO-6:	Use modern tools and standards to prepare and interpret design documentation.	K3

COURSE CONTENT:

MODULE 1:	**DESIGN OF TRANSFORMERS**	**10 Hours**
Output Equations of Single Phase and Three Phase Transformers, Choice of Specific Loadings, Expression for Volts/Turn, Determination of Main Dimensions of the Core, Estimation of Number of Turns and Conductor Cross Sectional area of Primary and Secondary Windings, No Load Current. Expression for the Leakage Reactance of core type transformer with concentric coils, and calculation of Voltage Regulation. Design of Tank and Cooling (Round and Rectangular) Tubes.		
MODULE 2:	**DESIGN OF INDUCTION MACHINE**	**10 Hours**
Output equation of Induction motor, Main dimensions, Length of air gap, Rules for selecting rotor slots of squirrel cage machines, Design of rotor bars & slots, Design of end rings, Design of wound rotor, Magnetic leakage calculations, Leakage reactance of polyphase machines, Magnetizing current, short circuit current, Circle diagram, Operating characteristics.		
MODULE 3:	**DESIGN OF DC MACHINES**	**10 Hours**
Output Equation, Choice of Specific Loadings and Choice of Number of Poles, Main Dimensions of armature, Design of Armature Slot Dimensions, Commutator and Brushes. Estimation of Ampere Turns for the Magnetic Circuit. Dimensions of Yoke, Main Pole and Air Gap. Design of Shunt and Series Field Windings.		
TOTAL LECTURES		**30 Hours**

Books:

1. A Course in Electrical Machine Design by A.K. Sawhney

CO-PO-PSO MAPPING:

CO/PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO-1	3	2	2	-	2	-	-	-	-	1	-	2	3	3	-
CO-2	3	3	3	2	3	-	-	-	-	2	-	2	3	3	-

CO-3	3	3	3	2	3	-	-	-	-	2	-	2	3	3	-
CO-4	3	3	3	2	3	-	-	-	-	2	-	2	3	3	-
CO-5	3	3	3	2	3	-	-	-	-	2	-	2	3	3	-
CO-6	3	3	3	3	3	3	-	-	2	3	-	3	3	3	2
	3.0	2.8	2.8	2.2	2.8	3.0	-	-	2.0	2.0	-	2.2	3.0	3.0	2.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Project Work-I	**Subject Code:** TIU-UEE-P499
Contact Hours/Week: 0-0-4 (L-T-P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. To enable students to conceptualize and plan a comprehensive project relevant to electrical engineering.
2. To develop the ability to conduct literature reviews and analyse existing solutions related to the chosen project topic.

3. To apply theoretical knowledge and technical skills acquired throughout the program to practical and innovative project development.
4. To enhance problem-solving abilities and critical thinking through project design and implementation.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To conceptualize and plan a comprehensive project relevant to electrical engineering	K6
CO-2:	To conduct literature reviews and analyse existing solutions related to the chosen project topic	K4
CO-3:	To apply theoretical knowledge and technical skills in practical and innovative project development.	K3
CO-4:	To demonstrate problem-solving abilities and critical thinking through project design and implementation.	K5
CO-5:	To prepare technical documentation and present project outcomes effectively	K5
CO-6:	To work collaboratively as a team, demonstrating effective communication and coordination skills	K3

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	3	3	2	2	-	3	2	2	3	3	3	2
CO-2	3	3	2	3	3	2	2	-	3	2	2	3	3	3	2
CO-3	3	3	3	3	3	2	2	-	3	2	2	3	3	3	3
CO-4	3	3	3	3	3	2	2	-	3	2	2	3	3	3	3
CO-5	2	2	2	2	2	2	2	-	3	3	3	2	3	3	2
CO-6	2	2	2	2	2	2	2	-	3	3	3	2	3	3	2
	2.7	2.5	2.5	2.7	2.7	2.0	2.0	-	3.0	2.3	2.3	2.7	3.0	3.0	2.3

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 7th Sem
Course Title: Industrial Training	**Subject Code:** TIU-UEE-I499
Contact Hours/Week: 0-0-4 (L-T-P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

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1. To provide students with hands-on experience in real-world industrial environments, enhancing their practical knowledge.
2. To bridge the gap between classroom learning and industry practices by applying theoretical concepts to practical situations.
3. To enhance technical proficiency and managerial skills through direct involvement in industrial processes and projects.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To gain practical industry exposure and enhance practical knowledge in real-world industrial environments.	K3
CO-2:	To apply theoretical concepts to practical situations and bridge the gap between classroom learning and industry practices.	K3
CO-3:	To develop technical and managerial skills through involvement in industrial processes and projects	K4
CO-4:	To understand industrial standards, protocols, and practices commonly followed in modern electrical engineering industries.	K2
CO-5:	To analyse and solve engineering problems encountered in an industrial setting.	K4
CO-6:	To demonstrate effective communication and teamwork skills during training in multidisciplinary environments.	K3

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	3	2	3	2	2	-	3	2	2	3	3	3	3
CO-2	3	2	3	2	3	2	2	-	3	2	2	3	3	3	3
CO-3	3	2	3	2	3	2	2	-	3	2	2	3	3	3	3
CO-4	3	2	3	2	3	2	2	-	3	2	2	3	3	3	3
CO-5	3	2	3	2	3	2	2	-	3	2	2	3	3	3	3
CO-6	2	2	2	2	2	2	2	-	3	3	3	2	3	3	2
	2.8	2.0	2.8	2.0	2.8	2.0	2.0	-	3.0	2.2	2.2	2.8	3.0	3.0	2.8

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SEMESTER 8

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem

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Course Title: Principle of Management	**Subject Code:** TIU-UMG-T412
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. To understand the in-depth concept of management.
2. To comprehend the concept of organizational Departmentalization.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1	To understand the basic concepts, principles, and theories of management.	K2
CO-2	To Understand the significance of planning and strategic management	K2
CO-3	To Understand the application of the principles of management to the functioning of an organization	K4
CO-4	To Understanding the significance of motivational techniques	K3
CO-5	To understand the use of computer-based tools for management	K2
CO-6	Analyse organizational structures, leadership styles, and communication methods in various management environments.	K4

COURSE CONTENT:

MODULE 1:	**Management**	**10 Hours**
Definition of management, science or art, manager vs entrepreneur; Types of managers, managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.		
MODULE 2:	**Planning and Control**	**10 Hours**
Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.		
MODULE 3:	**Decision Making and Organizing**	**10 Hours**
Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.		
MODULE 4:	**Staffing and Motivation**	**10 Hours**
Directing, individual and group behaviour, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.		

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.	
TOTAL LECTURES	**40 Hours**

Books:

1. Greenberg Jerald and Baron Robert A.: Behaviour in Organisations: Understanding and Managing the Human Side of Work, Prentice Hall of India.
2. Kaul Vijay Kumar, Business Organisation & Management - Text and Cases, Pearson.
3. Kaul, Vijay Kumar, Management- Text & Cases, Vikas Publication.
4. Kavita Singh: Organisational Behaviour, Vikas Publication.

Reference Books:

1. Koontz & Heinz Weihrich: Essential of Management, McGraw Hill.
2. Luthans Fred: Organisational Behaviour, Tata McGraw Hill.
3. Mc Shane L. Steven, Glinow Mary Ann Von & Sharma Radha R. – Organisational Behaviour; Tata McGraw Hill.
4. Newstrom John W.: Organisational Behaviour, Tata McGraw Hill.
5. Richard L. Daft: Principles of Management, Cengage Learning India.

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	-	2	3	-	-	2	3	-	-	2	2	-
CO-2	3	3	2	-	2	3	-	-	2	3	-	-	2	2	-
CO-3	3	3	2	-	2	3	-	-	3	3	-	-	2	2	-
CO-4	3	3	2	-	2	3	-	-	3	3	-	-	2	2	-
CO-5	3	3	3	-	3	3	-	-	2	3	-	-	2	2	-
CO-6	3	3	3	-	3	3	-	-	3	3	-	-	2	2	-
	3.0	3.0	2.3	-	2.3	3.0	-	-	2.5	3.0	-	-	2.0	2.0	-

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Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Communication Engineering	**Subject Code:** TIU-UEE-T404
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit: 4**

COURSE OBJECTIVE:

Enable the student to:

1. understand different signal processing and signal transmission techniques.
2. analyse the concepts and methods of analog and digital communication.
3. develop fundamental idea on different spread spectrum modulation techniques and wireless communication.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Interpret the fundamental concepts of signal processing and signal transmission.	K3
CO-2:	Analyse analog communication systems including modulation and demodulation techniques.	K4
CO-3:	Interpret different pulse modulation techniques and the process of digital representation of analog signals.	K3
CO-4:	Analyse digital communication systems including modulation and demodulation techniques.	K4
CO-5:	Identify the importance and different types of spread spectrum modulation.	K2
CO-6:	Apply the fundamental concepts of wireless communication.	K3

COURSE CONTENT:

MODULE 1:	**4 Hours**
Review of Fourier Transform and Random Process, Power Spectral Density (PSD), Auto-Correlation and Cross-Correlation Functions, Geometric Representation of Signals, Analog and Digital Signal Transmission and Reception, Channel and Noise, White Noise, Baseband and Carrier Communications.	
MODULE 2:	**12 Hours**
Analog Communication: Amplitude Modulation (AM), Modulation Index, Double Sideband-Suppressed Carrier (DSB-SC), Conventional Double Sideband (DSB) and Single Sideband (SSB) Modulation, Demodulation of AM Signals, AM Modulators (Power-law Modulators, Switching Modulator, Ring Modulator) and Demodulators (Synchronous Demodulator. Rectifier Detector, Envelop Detector), Frequency Division Multiplexing (FDM), Angle Modulation: Frequency and Phase Modulations (FM & PM), Narrowband and Wideband FM, FM Modulators and Demodulators. Direct and Indirect FM, Balanced Discriminator. FMFB and PLL FM Demodulators, AM and FM Radio Broadcasting, Superheterodyne AM and FM Receivers.	
MODULE 3:	**12 Hours**
Digital Communication: Digital Communication Systems, Communication Channels (AWGN, Bandlimited,	

Multipath and Fading Channels). introduction to Baseband and Bandpass Digital Modulations, Concepts or Power Efficiency, Bandwidth Efficiency. lnterSymbol Interference (ISI), Bit-Error Rate (BER), Formatting and Baseband Modulation, Messages, Characters, and Symbols, M-aryCommunicaton, PAM, PDM, PPM, Pulse Code Modulation (PCM), Delta Modulation, Uniform and Non-Uniform Quantizations, Companding, Time-Division Multiplexing (TDM), Baseband Demodulation. Digital Bandpass Modulation & Demodulation (Detection), Coherent Detection, Non-Coherent Detection, Frequency Shift Keying (FSK). Binary FSK Signals (BFSK), BFSK Modulator, BFSK Coherent and Non-Coherent Demodulators, Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), BPSK, BPSK Modulator, BPSK Coherent and Non-Coherent and Demodulators, Overview of M-ary PSK, Quadrature PSK and Minimum Shift Keying (MSK).
MODULE 4: 8 Hours
Spread-Spectrum (SS) Modulation: Direct-Sequence (DS) and Frequency-Hop (FH) SS, Concept of Pseudo-Noise (PN) Sequences, Generation of PN Sequences, SS Modulation for Baseband Transmission, DS SS with Coherent BPSK (DS/BPSK), DS/BPSK Transmitter and Receiver, Processing Gain, FH/MFSK Transmitter, Slow Frequency Hopping and Fast Frequency Hopping.
MODULE 5: 12 Hours
Wireless Communications: The Cellular Concept, Personal Communication Services (PCS), Hierarchical Architecture of a Personal Communication Services Network (PCSN), Radio Resource Managementin PCS, Multiple-Access Techniques, FDMA, TDMA, CDMA, Channel Assignment, Frequency Reuse, Cell Splitting. Mobi1ity Management, Handoff Management, Inter-Switch Handoff, Location Management, Location Update, Call Delivery and Terminal Paging, GSM (2.5 G) and UMTS (3G) Architectures.
TOTAL LECTURES 48 Hours

Books:

1. Communication Systems Engineering: John G. Proakis and Masoud Salehi
2. Communication Systems: Simon Haykin
3. Wireless Communications Principles and Practice: T. S. Rappaport

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	2	2	2	-	-	-	-	2	-	-	3	3	-
CO-2	3	3	3	2	3	-	-	-	-	2	-	-	3	3	-
CO-3	3	3	3	2	3	-	-	-	-	2	-	-	3	3	-
CO-4	3	3	3	2	3	-	-	-	-	2	-	-	3	3	-
CO-5	3	3	2	2	2	-	-	-	-	2	-	-	3	3	-
CO-6	3	3	3	2	3	-	-	-	-	2	-	-	3	3	-
	3.0	3.0	2.7	2.0	2.7	-	-	-	-	2.0	-	-	3.0	3.0	-

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Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Energy Conservation and Audit	**Subject Code:** TIU-UEE-E406B
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. understand the energy management and energy management opportunities.
2. understand the procedure for energy conversion in powerplants, HVAC systems, identify opportunities for conservation and usage of renewables.
3. understand the techniques for energy audit and apply the knowledge for economic analysis and energy management.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To understand the concept of energy management and energy management opportunities	K2
CO-2:	To understand the different methods used to control peak demand	K2
CO-3:	To know and apply energy auditing procedure	K3
CO-4:	To understand different renewable energy technologies	K2
CO-5:	To understand the different methods used for the economic analysis and evaluate energy projects.	K4
CO-6:	Apply energy conservation methods in various industrial systems like boilers, compressors, HVAC, and electrical systems.	K3

COURSE CONTENT:

MODULE 1:	**PRINCIPLES OF ENERGY MANAGEMENT**	**2 Hours**
General principles of Energy management and Energy management planning.		
MODULE 2:	**INDUSTRIAL ENERGY MANAGEMENT**	**6 Hours**
Peak Demand controls, Methodologies, Types of Industrial Loads, Optimal Load Scheduling-Case studies. Energy management opportunities in Lighting and Motors. Electrolytic Process and Electric heating, Case studies.		
MODULE 3:	**ENERGY CONSERVATION IN POWER PLANTS**	**8 Hours**
Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down,		

Energy conservation opportunities in boiler. Properties of steam, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery.		
MODULE 4:	**RENEWABLE ENERGY**	**10 Hours**
Physics of Wind Power, Wind generator topologies, The Solar Resource, Solar photovoltaic, Solar thermal power generation, Grid-integration issues.		
MODULE 5:	**HVAC SYSTEM**	**8 Hours**
HVAC system: Coefficient of performance, Capacity, Factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Classification and Advantages of Waste Heat Recovery system, analysis of waste heat recovery for Energy saving opportunities.		
MODULE 6:	**ENERGY AUDIT**	**10 Hours**
Energy audit - Definition, Need, Types of energy audit, Energy audit Instruments. Cogeneration-Types and Schemes, Optimal operation of cogeneration plants- Case study. Computer aided energy management, Economic analysis methods-cash flow model, time value of money, evaluation of proposals, pay-back method, average rate of return method, internal rate of return method, present value method, life cycle costing approach, Case studies.		
TOTAL LECTURES		**44 Hours**

Books:

1. Albert Thumann, William J. Younger, "Handbook of Energy Audits", CRC Press, 2003.
2. Charles M. Gottschalk, "Industrial energy conservation", John Wiley & Sons, 1996.
3. Craig B. Smith, "Energy management principles", Pergamon Press.
4. D. Yogi Goswami, Frank Kreith, "Energy Management and Conservation Handbook", CRC Press, 2007
5. G.G. Rajan, "Optimizing energy efficiencies in industry", Tata McGraw Hill, Pub.Co., 2001.

References

Reference materials given for National Certification Examination of Energy Manager and Energy Auditors.

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	3	3	3	-	-	2	-	2	3	3	3
CO-2	3	3	2	2	3	2	2	-	-	2	-	2	3	3	3
CO-3	3	3	3	3	3	3	2	-	-	2	-	3	3	3	3
CO-4	3	2	2	2	3	3	3	-	-	2	-	2	3	3	3
CO-5	3	3	3	3	3	2	2	-	-	2	-	3	3	3	3
CO-6	3	2	2	2	3	3	2	-	-	2	-	2	3	3	3

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	3.0	2.5	2.3	2.3	3.0	2.7	2.3	-	-	2.0	-	2.3	3.0	3.0	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Machine Learning	**Subject Code:** TIU-UEE-E406
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. To learn various types of machine learning techniques like Supervised learning, Unsupervised learning, Regression etc.
2. To learn briefly probability theory applied to machine learning
3. To learn various types of classification techniques and performance parameters for classification model under supervised learning.
4. To learn various clustering techniques under unsupervised learning
5. To learn various artificial neural networks, especially multi-layer feed forward back-propagation neural network

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Students will be capable to decide which type of learning technique to be applied for any practical problem, depending on the availability or non-availability of type of past data; whether the problem will be of classification or regression or clustering etc.	K4
CO-2:	Students will have refresher exposure to prior probability and posterior probability for the application of Bayes classifier and various probability distribution functions required for machine learning problems.	K3
CO-3:	Students will have good exposure to various classification techniques required for prediction in practical problems. Students will learn various performance measures for any classification model.	K2
CO-4:	Students will learn various regression techniques and decide which technique is suitable to be applied for any practical application.	K3
CO-5:	Students will be able to solve clustering problem for unsupervised learning where the past training data are not available.	K3
CO-6:	Students will be able to solve any forecasting problem for many practical applications where the large amount of input training data and corresponding outputs are available as	K3

	supervised learning.	

COURSE CONTENT:

MODULE 1:	**Introduction to Machine Learning**	**06 Hours**
Brief Descriptions of Supervised learning, Classification, Regression, Unsupervised learning, Reinforcement learning, Comparison of Learning methods, Applications of machine Learning		
MODULE 2:	Probability Distributions	**04 Hours**
Bernoulli distribution, Binomial distribution, Bayesian distribution, Gaussian distribution. Laplace distribution, multivariate Gaussian distribution		
MODULE 3:	Supervised learning-Classification	**10 Hours**
K-Nearest Neighbour, Decision Tree, Random Forest, Support Vector Machines, Naïve-Bayes classifier, Fuzzy classification, Underfitting and Overfitting, Evaluation of various performance parameters for any classification model,		
MODULE 4:	Supervised learning: Regression	**06 Hours**
Linear regression, Nonlinear regression, Logistic regression		
MODULE 5:	Unsupervised learning	**06 Hours**
Clustering techniques Partitioning Methods, Hierarchical clustering, Fuzzy C-means clustering and Entropy based clustering.		
Module-6	Neural networks	**08 Hours**
Artificial Neuron, Activation Functions, Architectures, Feed Forward Networks, Learning process in ANN, Back Propagation. Introduction to Deep Learning networks.		
TOTAL LECTURES		**40 Hours**

Books:

1. Pattern Recognition and Machine Learning by Christopher M. Bishop, Springer
2. Machine Learning Step by Step by Rudolph Russel.
3. Machine Learning by S. Dutta, S. Chadramouli and A.K. Das, Pearson Education, India
4. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C Muller and Sarah Guide
5. Understanding Machine Learning: From Theory to Algorithms by Shalev-Shwartz and Shai Ben-David, Cambridge University Press
6. Machine Learning for Absolute Beginners by Oliver Theobald, eBook
7. Deep Learning by Goodfellow, MIT press

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CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	3	2	3	-	-	-	-	2	-	2	3	3	3
CO-2	3	2	2	2	3	-	-	-	-	2	-	2	3	3	3
CO-3	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO-4	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO-5	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
CO-6	3	3	3	3	3	-	-	-	-	2	-	3	3	3	3
	3.0	2.8	2.8	2.7	3.0	-	-	-	-	2.0	-	2.7	3.0	3.0	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Career Advancement and Skill Development (PCB Designing)	**Subject Code:** TIU-UEE-S400
Contact Hours/Week: 3-0-0 (L-T-P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Introduce students to the fundamentals of PCB design, including types, materials, and fabrication techniques.
2. Develop skills in schematic design and circuit simulation using industry-standard PCB design software.
3. Enable students to create optimized PCB layouts by understanding routing techniques, signal integrity, and thermal management.
4. Familiarize students with PCB fabrication processes, including etching, soldering, and assembly techniques.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	Understand the fundamentals of PCB design, including materials, fabrication techniques, and design rules.	K2
CO-2:	Apply schematic design principles to create circuit diagrams using PCB design software.	K3
CO-3:	Analyse and optimize PCB layouts for signal integrity, thermal management, and electromagnetic interference (EMI).	K4
CO-4:	Design and implement single-layer, multi-layer, and flexible PCBs for real-world applications.	K4

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CO-5:	Evaluate PCB designs using simulation and testing tools for performance verification.	K4
CO-6:	Demonstrate PCB fabrication, assembly, and troubleshooting techniques for electrical and electronic applications.	K3

COURSE CONTENT:

MODULE 1:	**Introduction to PCB Design**	**6 Hours**
Basics of Printed Circuit Boards (PCBs): Types, Materials, and Manufacturing Process - Importance of PCB Design in Electrical Engineering - PCB Design Workflow: Schematic Design, Layout, Routing, Fabrication, and Testing		
MODULE 2:	**Schematic Design & Component Selection**	**6 Hours**
Circuit Schematic Design Principles - Selection of Electronic Components and Footprint Creation- Netlist Generation and Electrical Rule Checking (ERC)		
MODULE 3:	**PCB Layout Design & Routing Techniques**	**6 Hours**
PCB Layout Guidelines: Traces, Pads, and Vias - Routing Techniques: Manual vs. Auto-routing, Single-layer vs. Multi-layer PCB - Signal Integrity Considerations: Impedance Matching, Crosstalk, Grounding Strategies		
MODULE 4:	**Thermal & EMI Considerations in PCB Design**	**6 Hours**
Heat Dissipation Strategies: Thermal Relief, Heat Sinks, and Via Placement - Electromagnetic Interference (EMI) and Shielding Techniques - High-Speed PCB Design Considerations		
MODULE 5:	**PCB Fabrication & Assembly Process**	**9 Hours**
PCB Prototyping Techniques: Etching, Milling, and Photoengraving - Soldering Techniques: SMT (Surface Mount Technology) and THT (Through-Hole Technology) - Design for Manufacturing (DFM) and Design for Testability (DFT)		
MODULE 6:	**Testing, Debugging & Industry Applications**	**6 Hours**
PCB Testing Methods: Continuity Testing, Signal Testing, and Debugging Techniques - Fault Diagnosis & Repair of Defective PCBs - Applications of PCB Design in Electrical & IoT Systems		
TOTAL LECTURES		**39 Hours**

Books:

1. "Make Your Own PCBs with Eagle: From Schematic Designs to Finished Boards" – by Simon Monk
2. "Printed Circuit Boards: Design and Technology" – by Walter C. Bosshart
3. "Complete PCB Design Using OrCAD Capture and PCB Editor" – by Kraig Mitzner

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	3	-	2	-	-	2	-	2	3	3	3
CO-2	3	2	3	2	3	-	-	-	-	2	-	2	3	3	3

CO-3	3	3	3	3	3	-	2	-	-	2	-	3	3	3	3
CO-4	3	3	3	3	3	-	2	-	-	2	-	3	3	3	3
CO-5	3	3	3	3	3	-	2	-	-	2	-	3	3	3	3
CO-6	3	3	3	3	3	-	2	-	2	2	-	3	3	3	3
	3.0	2.7	2.8	2.7	3.0	-	2.0	-	2.0	2.0	-	2.7	3.0	3.0	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Project Work-II	**Subject Code:** TIU-UEE-P498
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. To enable students to develop and implement complex engineering projects that demonstrate advanced technical and analytical skills.
2. To encourage innovation by identifying and addressing real-world engineering challenges through creative solutions.
3. To utilize modern engineering tools, software, and methodologies in project development and execution.
4. To enhance students' ability to critically analyse project outcomes and evaluate the effectiveness of solutions.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO-1:	To develop and implement complex engineering projects demonstrating advanced technical and analytical skills.	K6
CO-2:	To identify and address real-world engineering challenges through innovative problem-solving approaches.	K5

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CO-3:	To utilize modern engineering tools, software, and methodologies in project development and execution.	K3
CO-4:	To critically analyse project outcomes and evaluate the effectiveness of implemented solutions.	K4
CO-5:	To prepare comprehensive technical documentation and present project findings professionally.	K5
CO-6:	To demonstrate teamwork, professional ethics, and effective communication during project execution and presentation.	K3

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	3	3	3	3	-	-	-	3	2	2	3	3	3	3
CO-2	3	3	3	3	3	-	-	-	2	2	2	3	3	3	3
CO-3	3	3	3	3	3	-	-	-	2	2	2	3	3	3	3
CO-4	3	3	3	3	3	-	-	-	2	2	2	3	3	3	3
CO-5	3	2	2	2	2	-	-	-	2	3	3	3	3	3	3
CO-6	3	2	2	2	2	3	2	2	3	3	3	3	3	3	3
	3.0	2.7	2.7	2.7	2.7	3.0	2.0	2.0	2.3	2.3	2.3	3.0	3.0	3.0	3.0

Program: B. Tech. in EE (BEE)	**Year, Semester: 4th** Yr., 8th Sem
Course Title: Grand Viva	**Subject Code:** TIU-UEE-G498
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit: 2**

COURSE OBJECTIVE:

Enable the student to:

1. To evaluate students' understanding and retention of fundamental and advanced concepts covered throughout the B. Tech. program.
2. To assess the ability to apply theoretical knowledge to solve practical engineering problems.
3. To develop confidence and clarity in presenting technical ideas and responding to questions during viva sessions.
4. To encourage the integration of knowledge from various subjects to address complex engineering challenges.

COURSE OUTCOME:

On completion of the course, the student will be able to:

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CO-1:	To evaluate understanding and retention of fundamental and advanced concepts covered throughout the B. Tech. program.	K5
CO-2:	To apply theoretical knowledge to solve practical engineering problems during viva sessions.	K3
CO-3:	To develop confidence and clarity in presenting technical ideas and responding to questions during viva sessions.	K3
CO-4:	To integrate knowledge from various subjects to address complex engineering challenges.	K6
CO-5:	To prepare for professional and academic challenges by demonstrating conceptual clarity and technical proficiency.	K4
CO-6:	To reflect on their learning journey, strengths, and areas for improvement.	K6

CO-PO-PSO MAPPING:

CO/PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	2	2	2	2	-	-	-	-	3	-	2	3	2	2
CO-2	3	3	3	2	3	-	-	-	-	3	-	2	3	3	2
CO-3	2	2	2	-	2	-	-	-	3	3	-	2	2	2	2
CO-4	3	3	3	2	3	-	-	-	-	2	-	3	3	3	2
CO-5	3	3	2	2	3	-	-	-	-	3	2	3	3	3	2
CO-6	2	2	2	-	2	-	-	-	-	2	2	3	2	2	2
	2.7	2.5	2.3	2.0	2.5	-	-	-	3.0	2.7	2.0	2.5	2.7	2.5	2.0