Scheme of Instruction

(In line with AICTE Model Curriculum with effect from AY 2025-26)

BACHELOR OF ENGINEERING

FOUR-YEAR DEGREE PROGRAMME
IN
Electronics and Communication Engineering (ECE)

(R–25Regulation)

MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY
An Autonomous Institution
Affiliated to Osmania University, Approved by AICTE
Accredited by NBA &NAAC(A+)

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MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY
(UGC Autonomous Institution)

B.E. Electronics and Communication Engineering (ECE)

SEMESTER-3			Scheme of Instruction				Scheme of Examination			Credits
S. No	Course Code	Name of the Course	Lecture	Tutorial	Practical	Contact	CIE	SEE	Duration	
1	25BS211MT	Complex Variables, Fourier series and Fourier Transforms	3	-	-	3	40	60	3	3
2	25PC201EC	Electronic Circuit Analysis	3	1	-	4	40	60	3	4
3	25PC202EC	Digital Logic Design	3	-	-	3	40	60	3	3
4	25PC203EC	Probability Theory and Stochastic Processes	3	-	-	3	40	60	3	3
5	25PC204EC	Network Analysis & Synthesis	3	-	-	3	40	60	3	3
6	25PC251EC	Electronic Circuit Analysis Lab	-	-	2	2	40	60	3	1
7	25PC252EC	Networks and Simulation Lab	-	-	2	2	40	60	3	1
8	25PC253EC	Digital Logic Design Lab	-	-	2	2	40	60	3	1
9	25SD254EC	Skill Development Course : IOT	-	-	2	2	50	-	-	1
		Total	15	1	8	24	370	480	24	20

MC: Mandatory Course **BS:** Basic Science **ES:** Engineering Science

Course Code	Course Title						Core/Elective
25BS212MT	**COMPLEX VARIABLES, FOURIER SERIES AND FOURIER TRANSFORMS**						**Core**
Prerequisite	**Contact hours per week**				**CIE**	**SEE**	**Credits**
25BS101MT, 25BS103MT	**L**	**T**	**D**	**P**			
	3	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives: The course is taught with the objectives of enabling the student to:

1. Understand Limit, Continuity and Analyticity of complex variables.
2. Apply Cauchy's theorem and Cauchy's integral formula.
3. Apply Residue theorem and understand Bilinear transformation.
4. Perform Fourier series for a given range.
5. Perform Fourier sine and cosine transformations.

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

1. Examine analyticity in Cartesian and Polar forms.
2. Evaluate contour integrals of functions of complex variables.
3. Evaluation of real integrals using complex variables.
4. Obtain the Fourier series for a given function.
5. Obtain the Fourier sine and cosine transformations.

PC: Program core **SD:** Skill Development

CIE: Continuous Internal Evaluation **SEE:** Semester End Evaluation

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	2	1	2	1
CO2	3	3	1	2	-	-	-	-	-	-	-	2	1	2	1
CO3	3	3	2	2	-	-	-	-	-	-	-	2	1	3	1
CO4	3	2	2	1	-	-	-	-	-	-	-	1	1	3	2
CO5	3	3	2	2	1	-	-	-	-	-	-	1	2	3	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Complex Variables: Limit and Continuity of a function f(z), Derivative of f(z), Analytic functions, Cauchy – Riemann Equations (Both Cartesian and Polar forms), Harmonic functions.

UNIT II

Complex integration: Cauchy's theorem, Extension of Cauchy's theorem, Cauchy's integral formula, Generalized Cauchy's integral formula, Taylor's series of f(z), Laurent's series of

f(z).
UNIT III
Residues and Transformations: Zeros of an analytic function, Singularities of an analytic function, Residues, Residue theorem, Evaluation of real integrals using Residue theorem, Bilinear transformation.
UNIT IV
Fourier Series: Even and Odd functions, Dirichlet's conditions, Expansion of a function for a given range $(0,2\pi)$, $(-\pi,\pi)$, $(0,2l)$, $(-l,l)$, Half-range sine and cosine series.
UNIT V
Fourier Transforms: - Fourier sine transforms, Fourier cosine transforms, Finite Fourier sine transforms, Finite Fourier cosine transforms - simple illustrations.

Suggested Text Books:
1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication 43❑rd Edition, 2014.
2. R. K Jain, S.R.K Iyengar, Advanced Engineering Mathematics, Narosa Publication. 4Th Edition, 2014.
3. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand Publications.
Reference Text Books:
1. R. V. Churchill and J. W. Brown, Complex Variables and Applications, McGraw-Hill Education.
2. James Ward Brown and Ruel V. Churchill, Fourier Series and Boundary Value Problems, McGraw-Hill.

Course Code	Course Title						Core/PE/OE
25PC201EC	**ELECTRONIC CIRCUIT ANALYSIS**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC105EC	**3**	**1**	**-**	**-**	**40**	**60**	**4**

Course Objectives : The course is taught with the objectives of enabling the student to:

1. Analyze frequency response of Amplifiers in different frequency ranges.
2. Familiarize with concept and effect of negative feedback
3. Study positive feedback and Design different types of oscillators
4. Design Power Amplifiers and calculate their efficiencies
5. Understand the principles and operation of wave shaping circuits and multivibrators for signal conditioning and pulse generation applications.

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

1. Design and analyze frequency response of different amplifiers using BJT and FET.
2. Identify the type of negative feedback, analyze and design of negative feedback amplifiers
3. Design Audio Frequency and Radio Frequency oscillators.
4. Distinguish between the classes of Power Amplifiers and their design considerations.
5. Apply wave shaping circuits and multivibrators for signal conditioning and pulse generation applications.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO3	2	2	3	1	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	3	-	-	-
CO5	2	1	3	-	-	-	-	-	-	-	-	3	-	-	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I
Small signal amplifiers: Classification of amplifiers. Mid-frequency, Low-frequency and

high frequency analysis of single and Multistage RC coupled amplifier with BJT & FET. Analysis of Transformer coupled amplifier at mid-frequency, low-frequency and high frequency.
UNIT II
Feedback Amplifiers: The feedback concept, General characteristics of negative feedback amplifier, Effect of negative feedback on input and output impedances, voltage and current, series and shunt feedbacks, Stability considerations, Local Versus global feedback
UNIT III
Oscillators: Positive feedback and conditions for sinusoidal oscillations, RC oscillators, LC oscillators, Crystal oscillator, Amplitude and frequency stability of oscillator.Regulators: Transistorized series and shunt regulators**.**
UNIT IV
Large Signal Amplifiers: BJT as large signal audio amplifiers, Classes of operation, Harmonic distortion, power dissipation, efficiency calculations. Design considerations of transformer coupled and transform less push- pull audio power amplifiers under Class-A, Class-B, Class-D and Class-AB operations.
UNIT V
Linear Wave Shaping: High-pass and low-pass RC circuits, response to step, pulse, and square wave inputs, RC differentiator and integrator circuits. **Non-Linear Wave Shaping:** Diode clippers, clipping at two independent levels, clamping circuits, Clamping circuit theorem. **Multivibrators:** Bistable, monostable, and astablemultivibrators, Schmitt trigger using transistors

Suggested Text Books:
1. Jacob Millman, Christos Halkias, Chetan Parikh, *Integrated Electronics*, 2nded.,McGraw Hill Education (India) Private Limited, 2011.
2. S Salivahanan, N Kumar,and A Vallavaraj, *Electronic Devices and Circuits*,McGraw Hill,3rd edition,2010.
3. Donald A.Neamen, *Electronic Circuits: Analysis and Design*, 3rd edition, McGraw Hill,2006.
Reference Text Books:
1. Anand Kumar A, “Pulse and Digital Circuits”, Prentice-Hall of India private Limited, NewDelhi, 2007
2. J.Millman and H. Taub, “Pulse, Digital and switching waveforms”- McGraw- Hill, 1991.

Course Code	Course Title						Core/PE/OE
25PC202EC	**DIGITAL LOGIC DESIGN**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives: The course is taught with the objectives of enabling the student to:

1. Understand the fundamental principles of digital hardware design and number systems.
2. ApplyBoolean algebra and logic minimization techniques to implement combinational circuits efficiently.
3. Analyzethe functionality and timing characteristics of sequential circuits using various flip-flops and latches.
4. Design finite state machines (FSMs) for real-time digital applications using synchronous sequential logic.
5. Explore the architecture and design methodologies using programmable logic devices like PALs, PLAs, CPLDs, and FPGAs.

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

1. Explain the fundamentals of digital hardware design, logic gates, Boolean algebra, and logic synthesis.
2. Design and optimize combinational circuits using K-Map and Quine-Mc Cluskey methods.
3. Construct and analyze various sequential circuits including flip-flops, registers, and counters.
4. Develop FSM-based digital systems for sequence detection and generation using Mealy/Moore models.
5. Implementcombinational logic using PLDs such as PALs, PLAs, CPLDs, and FPGAs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1	–	–	–	–	–	–	–	2	1	–	–
CO2	3	3	3	2	1	–	–	–	–	–	–	3	2	–	–

CO3	3	3	3	2	2	–	–	–	–	–	–	3	3	–	–
CO4	3	3	3	3	2	–	–	–	1	–	–	3	3	1	–
CO5	3	2	3	2	3	–	–	–	–	–	–	3	3	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I
Design Concepts: Digital Hardware, Design process, Design of digital hardware. Number systems and codes. Introduction to logic circuits – Variables and functions, Logic gates and networks. Boolean algebra, Synthesis using gates, Design examples.
UNIT II
Logic Optimization: Optimized implementation of logic functions using K-Map and Quine-Mc Cluskey Tabular method. **Combinational Circuit Design**: Adders and Subtractors, Multiplexers, Demultiplexers, Parity Checkers and Generators, Decoders, Encoders, Code converters, BCD to 7-segment converter and Arithmetic comparator circuits.
UNIT III
Sequential Circuits: Basic Latch, Gated SR Latch, gated D Latch, Master-Slave edge triggered flip-flops, T Flip-flop, JK Flip-flop, Excitation tables, Timing diagrams and analysis, Flip flop conversions, Set-up and hold time, Registers and Counters.
UNIT IV
Synchronous Sequential Circuits: Basic Design Steps, Finite State machine (FSM) representation using Moore and Mealy state models, State minimization, Design of FSM for Sequence Generation and Detection, Algorithmic State Machine charts.
UNIT V
Design of combinational circuits using Programmable Logic Devices (PLDs): General structure of a Programmable Array Logic (PAL), Programmable Logic Arrays (PLAs), Structure of CPLDs and FPGAs, 2-input and 3-input lookup tables (LUTs).

Suggested Text Books:
1. Morris Mano and Michael D. Ciletti, “Digital Design”, Pearson, 6/e, 2021.
2. ZviKohavi, “Switching and Finite Automata Theory”, 3/e, Cambridge University Press New Delhi, 2011.
3. R. P Jain, “Modern Digital Electronics”,4/e, McGraw Hill Education (India) Private Limited, 2010.
Reference Text Books:
1. John F. Wakerly, *Digital Design: Principles and Practices*, 5th Edition, Pearson Education, 2018.
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, *Digital Systems: Principles and Applications*, 12th Edition, Pearson Education, 2016.

Course Code	**Course Title**						**Core/PE/OE**
25PC203EC	**PROBABILITY THEORY AND STOCHASTIC PROCESSES**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
	3		**-**	**-**	**40**	**60**	**3**

Course Objectives : The course is taught with the objectives of enabling the student to:

1. Understand fundamentals of probability, repeated trials and Baye's theorem.
2. Learn Random variable and distribution and density functions of different variables along with their mean and variance.
3. Learn two Random variables along with joint moments and its properties.
4. Understand elementary concepts of the Stochastic Processes and their temporal characteristics
5. Understand elementary concepts of the Stochastic Processes and their Spectral characteristics

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

1. Understand axioms of probability and prove some basic theorems of probability.
2. To understand different types of Random variables, their density and distribution functions
3. To learn bi-variate distributions and the operations on them.
4. To understand elementary concepts of the Stochastic Processes in the Temporal domain.
5. To analyze the frequency domain information of Stochastic Processes.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	–	–	–	–	–	–	–	1	–	2	1	–	–
CO2	3	2	–	–	–	–	–	–	–	1	–	3	2	–	–
CO3	3	2	–	–	–	–	–	–	–	1	–	3	3	–	–
CO4	3	2	–	–	–	–	–	–		1	–	3	3	–	–
CO5	3	2	–	–	–	–	–	–	–	1	–	3	3	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Concept of Probability: Probability introduced through Set Theory and Operations – Definitions and Axioms, Probability Space – Discrete and Continuous, Events - Mutually

Exclusive and independent events, Joint Probability, Conditional Probability, Total Probability &Baye's Theorem, Repeated Trials, Combined Experiments, Bernoulli Trials, Bernoulli's Theorem.
UNIT II
Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables. **Distribution & Density Functions and Operations on One Random Variable** Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Gamma, Rayleigh Distribution functions, Conditional Density and its Properties. Expected Value of a Random Variable, Function of a Random Variable g(x) and its distribution, Moments about the Origin, Central Moments and Variance, Characteristic Function, Moment Generating Function.
UNIT-III
Two Random Variables and operations: Bi-Variate Distributions: Joint Distribution and Density Function and their properties, Joint Moments, Co-Variance, Correlation and Degree of Correlation, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values. Central Limit Theorem (no proof). One Function of Two Random Variables, Two functions of two random variables.
UNIT-IV
Stochastic Processes – Temporal Characteristics: Definitions and types of Stochastic Processes, Introduction to stationarity (First, Second and n^{th} order),Wide Sense and Strict Sense Stationary Processes, Statistical independence, Time averages and ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance and its Properties.
UNIT-V
Stochastic Processes – Spectral Characteristics: Power Spectral Density and its properties; Relationship between Power Spectrum and Autocorrelation Function; Relationship between Cross-Power Spectrum and Cross-Correlation Function; White and colored noise, Linear Systems, Response to linear systems for stochastic inputs, Introduction to Gaussian, Poisson and Markov Processes.

Suggested Text Books:
1. Henry Stark and John W. Woods, *Probability and Random Processes with Application to Signal Processing*, 3rd edition, Pearson Education, 2014.
2. Athanasius Papoulis and S. Unnikrishna Pillai, *Probability, Random Variables and Stochastic Processes*, 4th edition, McGraw Hill, 2006.
3. 3.Peyton Z. Peebles, *Probability, Random Variables & Random Signal Principles*, 4th edition, Tata McGraw Hill, 2001.
Reference Text Books:
1. T Veerarajan, Probability, Statistics and Random Processes, McGraw Hill, 3rd edition

2. P Sri Hari, Probability and Random Variables,The Hi-Tech Publishers

Course Code	Course Title						Core/Elective
25PC204EC	**NETWORK ANALYSIS& SYNTHESIS**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
25ES102EE	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives: The course is taught with the objectives of enabling the student to:

1. Understand the concept of two-port networks and analyze them using different parameter representations such as**,** Y, ABCD and Hybrid parameters.
2. Study symmetrical and asymmetrical networks, determine their characteristic impedance, propagation constant, image impedance, and transfer constants.
3. Analyze and design different types of filters, including constant-k filters and m-derived filters for various frequency responses.
4. Design attenuators and equalizers for impedance matching and signal level control in communication and transmission systems.
5. Introduce the principles of network synthesis, including Hurwitz polynomials, positive real functions, and Foster and Cauer realizations of network functions.

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

1. Analyse two-port networks using Z, Y, ABCD and Hybrid parameters and determine relationships between them.
2. Evaluate characteristic impedance and propagation constants for symmetrical and asymmetrical networks.
3. Design and analyselow pass, high pass, band pass and band stop filters using constant-k and m-derived techniques.
4. Design attenuators, impedance matching networks and equalizers for signal conditioning applications.
5. **A**pply network synthesis techniques to realize electrical networks using Foster and Cauer forms.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4

CO1	3	3	1	2	1	–	–	–	–	–	1	2	–	2	–
CO2	3	3	3	2	2	–	–	–	–	–	1	2	–	2	–
CO3	3	3	3	2	2	–	–	–	–	–	1	3	–	3	–
CO4	3	3	3	2	2	–	–	–	–	–	1	2	–	3	–
CO5	3	3	2	2	2	–	–	–	–	–	1	3	–	2	–

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I
Two Port networks: Open-Circuit Impedance (Z) Parameters, Short-Circuit Admittance (Y) Parameters, Transmission (ABCD) Parameters, Hybrid (H) Parameters, Inter-Relationships of Different Parameters, Interconnection of Two-Port Networks, T- and π- Representation.
UNIT II
Symmetrical and Asymmetrical Networks: Characteristic impedance and propagation constant of symmetrical T and π networks, Image and iterative impedances, Image transfer constant and iterative transfer constant of asymmetrical L, T and π networks,
UNIT III
Filters- Classification of Filters, Constant-K filter- low-pass filter, high-pass filter, band-pass filter, band stop filter, limitation K-type (constant-k) filters, m-Derived Low-Pass Filter, m-derived high-Pass Filter, Design of Composite Filter
UNIT IV
Attenuators and Equalizers- Design of symmetrical T, π , Bridge-T and Lattice attenuators, impedance matching networks, Inverse networks, Equalizers, Constant resistance equalizer, full series and full shunt equalizer**.**
UNIT V
Network Synthesis: Hurwitz polynomials, positive real functions, Basic Philosophy of Synthesis, L-C Immitance functions, RC impedance functions and RL admittance functions. RL impedance functions and RC admittance functions. Cauer and Foster's forms of RL impedance and RC admittance.**.**

Suggested Text Books:
1. A Sudhakar and Shyammohan S Palli, "Circuits & Networks: Analysis and Synthesis", 5th ed., Tata McGraw-Hill , 2015
2. S.P. Ghosh and A.K. Chakraborty, *Network Analysis and Synthesis,* McGraw Hill, 1st edition, 2009.
3. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 6th edition, Tata McGraw-Hill, 2007.
Reference Text Books:
1. Ryder J.D, *Network Lines Fields*, 2nd edition, Prentice Hall of India,1991.
2. P.K. Jain and GurbirKau, *Networks, Filters and Transmission Lines,* Tata McGraw-Hill Publishing Company Limited.

Course Code	Course Title						Core/PE/OE
25PC251EC	**ELECTRONIC CIRCUIT ANALYSIS LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC201EC	**-**	**-**	**-**	2	**40**	**60**	**1**

Course Objectives: The course is taught with the objectives of enabling the student to:

1. Analyze and Verify frequency response of BJT and FET amplifiers.
2. Design different negative feedback amplifiers circuits.
3. Design AF and RF oscillator circuits.
4. Design power amplifiers.
5. Analyze and design RC waveform-shaping circuits and transistor-based multivibrators.

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

1. Design, construct, and evaluate RC-coupled amplifiers using BJTs.
2. Understand and implement different types of feedback topologies in amplifier circuits
3. Design and construct sinusoidal oscillator circuits
4. Analyze and design various amplifier circuits tuned, and power amplifiers using BJT and FET,
5. Apply RC circuits and transistor multivibrators to waveform shaping and pulse generation.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	–	–	–	–	–	–	2	1	2	–
CO2	3	3	2	2	2	–	–	–	–	–	–	2	1	2	–
CO3	3	3	3	2	2	–	–	–	–	–	–	2	2	2	–
CO4	3	3	2	3	2	–	–	–	–	–	1	2	2	3	–
CO5	3	3	2	3	3	–	–	–	–	–	1	2	2	2	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments

PART A
1. Design and plot the frequency response of a single-stage RC coupled amplifier using a BJT. Analyze the gain and bandwidth of the amplifier.
2. Design and plot the frequency response of a single-stage RC coupled amplifier using a FET. Analyze the gain and bandwidth of the amplifier.
3. Design and analyze a voltage series negative feedback amplifier. Measure the gain and observe the effect of feedback on bandwidth and distortion.
4. Design and analyze a current shunt negative feedback amplifier. Determine the changes in input/output impedance due to feedback.
5. Design and analyze a voltage shunt negative feedback amplifier. Observe and explain the changes in amplifier gain due to feedback.
6. Design, construct, and study a current series negative feedback amplifier. Measure the impact of feedback on the amplifier's stability and frequency response.
7. Simulate and analyze BJT amplifier circuits using SPICE. Plot frequency responses and compare simulation results with theoretical calculations
PART B
1. Design and analyze Hartley and Colpitts oscillators using BJTs. Calculate and compare the theoretical and practical oscillation frequencies.
2. Design RC phase shift oscillator using a BJT. Verify the frequency of oscillation and waveform .
3. Design and construct a Class-B power amplifier. Plot the input-output characteristics and evaluate power efficiency and distortion levels
4. Verify the characteristics of clipping and clamping circuits
5. Design and analyze the characteristics of a collector-coupled bistablemultivibrator using transistors
6. Design and analyze the characteristics of a collector-coupled MonostableMultivibrator using transistors
7. Design and analyze the characteristics of a collector-coupled Collector Coupled Astable Multivibrator using transistors

Note : Students are required to perform minimum 10 experiments, 5 experiments from Part A and 5 experiments Part B.

Suggested Text Books:
1. Paul B. Zbar, Albert P.Malvino, Michael Miller, *Basic Electronics, A Text- Lab Manual*,7th ed., McGraw Hill Education (India) Private Limited,2001
2. David Bell A, *Laboratory Manual for Electrical Circuits,* PHI-New Delhi, 2009
3. Hayt W H Kemmerly J.E and Durbin SM, *Engineering Circuit Analysis,* 8th ed., McGraw Hill Education (India) Private Limited, 2013.

Course Code	Course Title						Core/PE/OE
25PC252EC	**NETWORKS AND SIMULATION LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25ES102EE	-	-	-	2	40	60	1

Course Objectives : The course is taught with the objectives of enabling the student to:

1. Provide practical understanding of fundamental network theorems and their applications in electrical circuits.
2. Familiarize students with the experimental measurement of network parameters such as two-port parameters and impedance characteristics.
3. Introduce the design concepts of attenuators and filters used in communication and signal processing circuits.
4. Expose students to practical realization of network circuits such as constant-K filters, m-derived filters, and resonance circuits.
5. Develop skills in circuit simulation using SPICE tools for analyzing and validating network behavior.

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

1. Verify basic network theorems such as Superposition, Tellegen's theorem, Thevenin's theorem, and Maximum Power Transfer theorem through experiments and simulations.
2. Measure and evaluate two-port network parameters and understand their practical applications.
3. Introduce the design concepts of attenuators used for controlling signal levels in electrical and communication circuits.
4. Expose students to practical realization of network circuits such as constant-K filters, m-derived filters, and resonance circuits.
5. Use SPICE simulationtoolsto model, analyze, and verify electrical network behavior.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO 4
CO1	3	3	1	2	2	–	–	–	–	–	1	2	–	2	–
CO2	3	3	1	2	2	–	–	–	–	–	1	2	–	2	–
CO3	3	2	3	2	2	–	–	–	–	–	1	3	–	3	–
CO4	3	2	3	2	2	–	–	–	–	–	1	2	–	3	–
CO5	2	2	1	2	3	–	–	–	–	–	1	3	–	2	–

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments
PART-A
1. Verification of Superposition and Tellegan's theorem for Bridge T-Type network
2. Verification of Thevenin's and Maximum Power Transfer Theorem for Bridge T-Type network
3. Measurement of Z,Y Parameters for two-port network
4. Measurement of hybrid & Transmission parameters for two-port network..
5. Design and Implementation of T-Type and Bridge T-Type Attenuators
6. Measurement of Image impedance and Characteristics impedance.
7. Design and implementation of Constant-K (K-Type) low pass &High-Pass Filter
PART-B
1. Design and implementation of m-Derived low-Pass & high pass Filter
2. Design and Verification of SPICE/MATLAB/Multisim simulation of Superposition and Tellegan's theorem
3. Design and Verification of SPICE/MATLAB/ Multisim simulation of Thevenin's and Maximum Power Transfer
4. Simulation and Verification of Z Parameters & Y parameters of a two-port network using Multisim/spice/MATLAB.
5. Simulation and Verification of hybrid & Transmission parameters of a two-port network using Multisim/spice/MATLAB
6. Design and Verification of SPICE// MATLAB/Multisim simulation of Series Resonance.
7. Design, Verification of SPICE//MATLAB/Multisim simulation of Parallel Resonance.

Note: Students are required to perform minimum 10 experiments, 5 experiments from Part A and 5 experiments Part B.

Suggested Text Books:
1. A Sudhakar and Shyammohan S Palli, "Circuits & Networks: Analysis and Synthesis", 5thed., Tata McGraw-Hill , 2015
2. S.P. Ghosh and A.K. Chakraborty, *Network Analysis and Synthesis,* McGraw Hill, 1st edition, 2009.
3. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", 6th edition, Tata McGraw-Hill, 2007.

Course Code	Course Title						Core/PE/OE
25PC253EC	**DIGITAL LOGIC DESIGN LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC253EC	**-**	**-**	**-**	**2**	**40**	**60**	**1**
Course Objectives: The course is taught with the objectives of enabling the student to:							
1. To understand and verify the functionality of basic logic gates and standard combinational logic circuits.							
2. To design and realize combinational circuits using universal gates, multiplexers, and decoders.							
3. To verify and analyze the operation of various flip-flops and their conversions.							
4. To design and simulate sequential circuits including counters and shift registers using simulation tools.							
5. To introduce students to the basics of PCB design using CAD tools for digital/analog circuits.							
Course Outcomes: On completion of this course, the student will be able to:							
1. Verify the truth tables of basic logic gates and implement simple code converters using logic gates.							
2. Design and implement half and full adders/subtractors using universal gates, MUX, and decoders.							
3. Analyze the working of different flip-flops and perform flip-flop conversions to implement required memory elements.							
4. Simulate combinational and sequential logic circuits using digital design tools to validate logical functionality							
5. Create and simulate PCB layouts for simple analog/digital circuits using PCB design tools.							

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	2	–	–	–	–	–	–	3	2	–	–
CO2	3	2	3	2	2	–	–	–	1	–	–	3	2	–	–
CO3	3	2	3	2	3	–	–	–	–	–	–	3	3	–	–
CO4	3	2	3	2	3	–	–	–	–	–	–	3	3	1	–
CO5	3	2	3	2	3	–	–	–	1	–	–	3	3	1	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments

PART A

1. Verification of truth tables of Logic gates and realization of Binary to Gray and Gray to Binary code converters.
2. Realization of Half adder/subtractor using universal logic gates.
3. Realization of Full adder/subtractor using universal logic gates.
4. Realization of Full adder/Sub using MUX and Decoder
5. Verification of truth tables of Flip Flops and Flip flop conversions form one form to the other.
6. Design and realization of Synchronous and Asynchronous Counters using Flip-Flops and verification of their operation.

PART B

1. Design and simulation of basic logic gates and verification of their truth tables.
2. Design and simulation of Combinational circuits such as adders, subtractors, multiplexers, and demultiplexers
3. Design and Simulation of Sequential Circuits such as JK and D Flip Flops.
4. Design and Simulation of Sequential Circuits such as Counters and Shift Registers
5. Design a simple PCB layout for a given analog/digital circuit using CAD tools.
6. Design and realization of Synchronous and Asynchronous Counters using Flip-Flops and verification of their operation.

Note: Students are required to perform minimum 10 experiments, 5 experiments from Part A and 5 experiments Part B

Suggested Text Books:

1. David A. Bell, Lab Manual for Electronic Devices and Circuits, 4th Edition, PHI.
2. Zbar, Malvino, Miller, Basic Electronics: A Text Lab Manual.
3. M. H. Rashid, SPICE for Circuits and Electronics Using PSpice, Pearson.

MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECHNOLOGY
(UGC Autonomous Institution)

B.E. Electronics and Communication Engineering (ECE)

SEMESTER-4			Scheme of Instruction				Scheme of Examination			Credits
S. No	Course Code	Name of the Course	Lecture	Tutorial	Practical	Contact	CIE	SEE	Duration	
1	25PC205EC	Analog and Digital Communication	3	1	-	4	40	60	3	4
2	25PC206EC	Signals and Systems	3	-	-	3	40	60	3	3
3	25PC207EC	Electromagnetic Theory and Transmission Lines	3	-	-	3	40	60	3	3
4	25PC208EC	Control Systems	3	-	-	3	40	60	3	3
5	25PC209EC	Linear Integrated Circuit Applications	3	-	-	3	40	60	3	3

6	**25PC255EC**	**Analog and Digital CommunicationLab**	**-**	**-**	**2**	**2**	**40**	**60**	**3**	**1**
7	**25PC256EC**	**Signals and Control Systems Lab**	**-**	**-**	**2**	**2**	**40**	**60**	**3**	**1**
8	**25PC257EC**	**Linear Integrated Circuit Applications Lab**	**-**	**-**	**2**	**2**	**40**	**60**	**3**	**1**
9	**25PW258EC**	**Mini Project**	**-**	**-**	**6**	**6**	**40**	**60**	**3**	**3**
		Total	**15**	**1**	**12**	**28**	**360**	**540**	**27**	**22**

MC: Mandatory Course **BS:** Basic Science **ES:** Engineering Science

PC: Program core **SD:** Skill Development

CIE: Continuous Internal Evaluation **SEE:** Semester End Evaluation

Course Code	**Course Title**						**Core/PE/OE**
25PC205EC	**ANALOG AND DIGITAL COMMUNICATION**						**CORE**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
-	**3**	**1**	**-**	**-**	40	**60**	**4**

Course Objectives: The course is taught with the objectives of enabling the student to:

1. Understand fundamentals of communication, need for modulation, AM and FM modulation techniques.
2. Generation and detection of pulse modulation techniques.
3. Introduce the concepts of digital data transmission.
4. Analyze the error performance of different digital carrier modulation schemes like ASK, FSK, PSK etc.
5. Familiarize the students with the concepts of spread spectrum communication with emphasis on DSSS and FHSS.

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

1. Analyze the different analog modulation schemes.
2. Describe the various generation and detection of pulse modulation techniques.
3. Understand the elements of digital communication, PCM and Delta modulation.
4. Describe digital carrier modulation schemes and their comparison.
5. Understand generation of PN sequence and analyze the performance of Spread Spectrum communication systems.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	-	2	-	-	1	1	1	-	1	1	3	-
CO2	3	2	1	-	2	-	-	1	1	1	-	1	2	3	-
CO3	3	3	1	-	1	-	-	1	1	1	-	1	2	3	-
CO4	3	3	2	-	2	-	-	1	1	1	-	1	2	3	1
CO5	3	2	1	-	1	-	-	1	1	1	-	-	2	3	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Introduction: Elements of communication system, Classification of communication, Modulation process and need for modulation.
Amplitude Modulation (AM): Single tone Amplitude Modulation, frequency domain representation, power relations, and generation of AM(Square law modulation) , demodulation method (Envelope detector).
Angle Modulation: Frequency Modulation (FM) and Phase Modulation (PM), Single tone frequency modulation, FM Generation using reactance modulator and varactor diode method, detection of FM using phase discriminator and ratio detector.

UNIT II

Pulse Modulation Techniques:Sampling Theorem for low pas signals, Nyquist rate and Nyquist interval,
Generation and Demodulation of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), and Pulse Position Modulation (PPM), Comparison of various pulse modulation techniques.

UNIT-III

Introduction to Digital Communication:Elements of Digital Communication System**,** Comparison of Digital and Analog Communication.
Concept of quantization,
Pulse Code Modulation (PCM), Quantization error in PCM, Signal to Quantization noise ratio, Delta Modulation (DM), Drawbacks of DM, Adaptive Delta Modulation, Differential PCM (DPCM).

UNIT-IV

Digital Modulation Techniques:Optimum filter and matched filter, evaluation of probability of error of optimum filter, Description and generation of ASK, FSK, PSK. Signal Constellation, Coherent detection of Binary ASK, FSK, PSK and DPSK, probability of error of binary ASK, FSK and PSK, Comparison of digital carrier modulation schemes.

UNIT-V

Spread Spectrum Communication:Advantages of Spread Spectrum, generation and characteristics of PN sequences. Direct sequence spread spectrum and Frequency hopping spread spectrum systems. CDMA, ranging using DSSS. Acquisition and Tracking of DSSS and FHSS signals, applications of Spread spectrum techniques.

Suggested Text Books:

1. B. P. Lathi and Zhi Ding, *Modern Digital and Analog Communication Systems*, 4th Edition, Oxford University Press, 2009.

2.	Simon Haykin, *Digital Communication*, 4th Edition, Wiley India, 2011.
3.	Herbert Taub and Donald L. Schilling, *Principles of Communication Systems*, 2nd Edition, Tata McGraw-Hill, 2000.
Reference Text Books:	
1.	Sanjay Sharma, " Analog and Digital Communication", Katson Books.
2.	S.K. Venkat Ram, " Digital Communication", S.Chand and Company Ltd.

Course Code	**Course Title**						**Core/PE/OE**
25PC206EC	**SIGNALS AND SYSTEMS**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25BS211MT	**3**	**-**	**-**	**-**	**40**	**60**	**3**
Course Objectives: The course is taught with the objectives of enabling the student to:							
1. Analyze basic concepts related to signals and systems.							
2. Familiarize with basic operations on signals and mathematical representation of periodic and aperiodic signals.							
3. Define convolution, correlation operations on continuous signals.							
4. Define the characterization of system using constant coefficient difference equations.							
5. Analyze the response of systems upon application of step and ramp inputs using Fourier and Z transforms.							
Course Outcomes: On completion of this course, the student will be able to:							
1. Define and differentiate types of signals and systems in continuous and discrete time.							

2.	Apply the properties of Fourier transform for continuous time signals.
3.	Relate Laplace transforms to solve differential equations and to determine the response of the Continuous Time Linear Time Invariant Systems to known inputs.
4.	Apply Z-transforms for discrete time signals to solve Difference equations.
5.	Obtain Linear Convolution and Correlation of discrete time signals with graphical representation.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	1	-	-	-	-	1	-	1	2	3	-
CO2	3	3	2	-	2	-	-	-	-	1	-	1	2	3	1
CO3	3	3	2	2	2	-	-	-	-	1	-	1	2	3	1
CO4	3	3	2	2	2	-	-	-	-	1	-	1	2	3	2
CO5	3	2	-	2	2	-	-	-	-	1	-	1	2	3	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Definitions and classifications: Classification of continuous time signals. Basic operations on continuous-time signals and classification of continuous-time systems.
Discrete-time signals and systems: Sampling, Classification of discrete-time signals, Basic operations on discrete time signals, Basic operations on discrete time signals, Classification of discrete time systems, properties of systems.

UNIT II

Representation of Continuous-time signals: Analogy between vectors and signals, signal representation by a discrete- set of orthogonal functions, orthogonality and completeness.
Fourier series – Trigonometric and Exponential Fourier series, computational formulae, symmetry conditions, the complex Fourier spectrum.
Fourier Transform (FT): The direct and inverse FT, existence of FT, Properties of FT, The Frequency Spectrum.

UNIT III

Laplace Transform (LT): The direct LT, Region of convergence, existence of LT, properties of LT. The inverse LT, Solution of differential equations, system transfer function.
Linear convolution of continuous time signals: Graphical interpretation, properties of convolution, Correlation between continuous-time signals: Auto and Cross correlation, graphical interpretation, properties of correlation.

UNIT IV

Z-Transform: The direct Z transform, Region of convergence, Z-plane and S-plane correspondence. Inverse Z transform, Properties of Z-transforms, Solution to linear difference equations, Linear constant coefficient systems, System transfer function

UNIT V

Discrete Fourier series: Frequency domain Representation of discrete-time systems and signals. Sampling the z-transform. Linear Convolution of discrete time signals: Graphical interpretation, properties of discrete convolution.Correlation between discrete time signals: Auto and Cross-correlation, graphical interpretation, properties of correlation.

Suggested Text Books:

1. B.P.Lathi,LinearSystemsandSignals, OxfordUniversityPress,2nd Edition,2009
2. Alan V O P Penheim, A. S. Wlisky , Signals and Systems, 2nd Edition, PrenticeHall
3. Rodger E. Ziemer, William H Trenter, D. Ronald Fannin, Signals and Systems, 4th Edition, Pearson1998.

Reference Text Books:
1. Douglas K. Linder, Introduction to Signals and Systems, McGraw Hill, 1999
2. P. Ramakrishna Rao, Signals and Systems, TMH
3. P.RameshBabu,R Ananda Natrajan,Signals and systems SCITECH

Course Code	**Course Title**						**Core/PE/OE**
25PC207EC	**ELECTROMAGNETIC THEORY AND TRANSMISSION LINES**						**CORE**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25BS102PH	**3**	**-**	**-**	**-**	**40**	**60**	**3**
Course Objectives : The course is taught with the objectives of enabling the student to:							
1. Analyze fundamental concepts of vector analysis, electrostatics and magneto statics law and their applications to describe the relationship between Electromagnetic Theory and circuit theory							
2. Formulate the basic laws of static electricity and magnetism and extend them to time varying fields to define the Maxwell's equations in differential and integral form.							
3. Derive the wave equations for conducting and di-electric mediums to analyze the wave propagation characteristics of Uniform Plane Waves (UPW) in normal and oblique incidences							

4. Analyze fundamental concepts of Transmission lines and to formulate the basic relationship between distortion less transmission lines &applications.
5. Understand the concepts of RF Lines, their characteristics and analyze the applications of Smith Chart.
Course Outcomes : On completion of this course, the student will be able to :
1. Understand the different coordinate systems, vector calculus, coulombs law and gauss law for finding electric fields due to different charge distributions.
2. Learn basic magneto-statics concepts and laws such as Biot-Savart law and Amperes law, their application in finding magnetic field intensity.
3. Distinguish between the static and time-varying fields, establish the corresponding sets of Maxwell's Equations and Boundary Conditions, and use them for solving engineering problems.
4. Determine the Transmission Line parameters to characterize the distortions and estimate the characteristics for different lines.
5. Study the Smith Chart profile and stub matching features, and gain ability to practically use the same for solving practical problems

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	2	-	-	-	-	-	1	-	1	2	3	-
CO2	3	2	2	2	-	-	-	-	-	1	-	1	2	3	1
CO3	3	2	-	2	-	-	-	-	-	1	-	1	2	3	1
CO4	3	2	-	3	-	-	-	-	-	1	-	1	2	3	1
CO5	3	2	-	-	-	-	-	-	-	1	-	1	2	3	1

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively

UNIT I : Electrostatics:
Review of coordinate systems. Coulomb's Law, Electric Field Intensity, Electric field due to Line Charge , Sheet Charge and Volume Charge Distribution, Electric flux, Flux density. Gauss's Law and its applications. Energy and Potential, Potential of a point charge, System of Charges, Potential gradient.
UNIT II : Magneto-statics and Maxwell's Equations
Steady magnetic field -Biot-Savart's law, Ampere's law. Stoke's theorem, Magnetic flux and magnetic flux density. Scalar and vector magnetic potentials. Electric and Magnetic fields boundary conditions. Maxwell's equations for static and time varying fields.
UNIT III : Wave Equations and Reflection
Uniform plane waves in free space and in conducting medium, Wave Polarization- Linear, Circular and Elliptical Polarization, Poynting theorem. Reflection of Uniform Plane Wave at Normal incidence and oblique incidence on dielectrics medium, Reflection Coefficient, Transmission Coefficient.
UNIT IV: Transmission Lines at Low Frequency
Types of Transmission Lines-Two wire lines and its circuit representation, Primary and secondary constants. Transmission Line equations, Infinite line, characteristic impedance of Open and short circuit lines and their significance. Distortion less transmission line, Concept of loading of a transmission line, Campbell's formula.
UNIT V: Transmission Lines at High Frequency
Impedance at any point on the transmission line- Input impedance. RF and UHF lines, transmission lines as circuit elements. Properties of $\lambda/2$, $\lambda/4$ and $\lambda/8$ Lines. Reflection and VSWR. Matching: Stub matching. Smith chart and its applications.

Suggested Text Books:
1. Matthew N.O. Sadiku, Principles of Electro-magnetic, 6th edition, Oxford University Press, 2016
2. William H. Hayt Jr. and John A. Buck, Engineering Electromagnetics, 7th edition, Tata McGraw Hill, 2006.
3. John D. Ryder, Networks Lines and Fields, 2nd edition, Pearson, 2015.
Reference Text Books:
1. John D. Ryder, Networks Lines and Fields, 2nd edition, Pearson, 2015.
2. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd edition, Pearson, 2015

Course Code	**Course Title**						**Core/Elective**
25PC208EC	**CONTROL SYSTEMS**						**Core**
Prerequisite	**Contact Hours per Week**				**CIE**	**SEE**	**Credits**
	L	**T**	**D**	**P**			
25BS101MT	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives: The course is taught with the objectives of enabling the student to:
1. Introduce basic concepts of control systems, feedback effects, mathematical modeling, and system representation techniques.
2. Study time domain analysis of control systems using standard test signals and performance specifications.

3. Understand stability analysis of control systems using Routh–Hurwitz criterion and Root Locus techniques.
4. Introduce frequency response methods for analyzing control system performance and stability.
5. Understand state space representation and analysis of linear time invariant systems.

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

1. Develop the mathematical model of the physical systems and find the transfer function using different approaches.
2. Analyse time response of first and second order systems and evaluate steady state errors and controller effects.
3. Determine system stability and construct root locus plots for system analysis.
4. Analyse systems using Bode plots and Nyquist stability criterion.
5. Develop state models, obtain transfer functions, and analyze controllability and observability.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	2	-	-	-	-	-	1	-	1	2	3	-
CO2	3	2	2	2	-	-	-	-	-	1	-	1	2	3	1
CO3	3	2	-	2	-	-	-	-	-	1	-	1	2	3	1
CO4	3	2	2	3	-	-	-	-	-	1	-	1	2	3	-
CO5	3	3	-	2	-	-	-	-	-	1	-	1	2	3	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively

UNIT I

Control System Fundamentals: Classification of control systems including Open and Closed loop systems, Effect of feedback on Control systems, Mathematical modeling of Mechanical systems and their conversion into electrical systems, Transfer function representation, Block diagram representation, Block diagram algebra and reduction and Signal flow graphs and Mason's gain formula.

UNIT II

Time Domain Analysis: Standard test signals, Time response of first and second order systems with standard input signals, Time domain specifications, steady state error and error constants. Effects of P, PI, PD and PID Controllers

UNIT III

Stability Analysis in S-Domain: Concept of stability, Routh Hurwitz criterion. Construction of Root locus. Effects of adding poles and zeros to open loop transfer function on the root loci.

UNIT IV

Frequency Response Analysis: Introduction to Frequency response of the system. Correlation between time and frequency responses, Frequency domain Specifications, Bode plots, Stability analysis, Nyquist plot and Nyquist criterion for stability, Lead and Lag compensators**.**

UNIT V

State Space Representation: Concept of state and state variables. State models of linear time invariant systems, Derivation of Transfer Function from State Model, State transition matrix, Solution of state equations. Controllability and Observability.

Suggested Text Books:
1. Nagrath, I.J, and Gopal, M., "Control System Engineering", 5th edition, New Age Publishers, 2009
2. NagoorKani, "Control systems engineering", Oxford & IBH Publishing Company Private Limited, 2021.
3. Ogata, "Modern Control Engineering", 2/e, Prentice Hall of India.,2011.
Reference Text Books:
1. R.C. Sukla, "Control Systems", 3/e, Dhanpatrai and Sons,1998
2. Control Systems Engg. , Nise– John wiley , 3rd Edition 2000

Course Code	**Course Title**						**Core/PE/OE**
25PC209EC	**LINEAR IC APPLICATIONS**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC201EC	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives : The course is taught with the objectives of enabling the student to:
1. introduce the fundamentals of operational amplifiers, differential amplifiers, and the characteristics of IC 741
2. understand the design and operation of operational amplifier-based analog circuits

	and their practical applications
3.	Study the design and operation of active filters and oscillator circuits using operational amplifiers
4.	understand the operation and applications of IC 555 Timer, IC 565 PLL, and voltage regulator ICs
5.	understand the principles and operation of Digital-to-Analog and Analog-to-Digital converters
Course Outcomes : On completion of this course, the student will be able to :	
1.	Explain the operation, characteristics, and configurations of operational amplifiers and analyze differential amplifier circuits.
2.	Design and analyze Op-Amp application circuits for signal amplification, conversion, waveform shaping, and signal processing
3.	Design and analyze active filters and oscillator circuits to generate and process analog signals
4.	Design and analyze timer, PLL, and voltage regulator circuits for timing, frequency control, and power regulation applications
5.	Analyze and compare different DAC and ADC architectures based on their performance characteristics

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	2	-	-	-	-	-	2	-	1	3	2	-
CO2	3	2	2	2	-	-	-	-	-	1	-	1	3	2	-
CO3	3	2	-	3	-	-	-	-	-	1	-	1	3	2	1
CO4	3	2	2	3	-	-	-	-	-	1	-	1	3	2	1
CO5	3	2	-	2	-	-	-	-	-	1	-	1	3	2	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively

UNIT I
Differential & Operational Amplifiers: OP-Amp Block diagram, DC and AC Analysis of Single/ Dual input Balanced and Unbalanced output of differential Amplifier using BJT, Level Translator, ideal Op-Amp characteristics, AC &DC Characteristics of Op-Amp, Op-Amp Configurations, IC 741 features and Pin diagram
UNIT II
Operational Amplifier Applications: Inverting and Non-Inverting Amplifiers, summing amplifier, instrumentation amplifier, V to I and I to V converters, Sample & hold circuits, multipliers and dividers, Integrator and differentiator, precision rectifier, comparators, Schmitt trigger, Multivibrators, Log and Anti Log Amplifiers
UNIT III
Active Filters &Oscillators: Introduction, Low pass, high pass, band pass and band stop, and all pass filters. Oscillator types and principle of operation - RC, Wien and quadrature type, waveform generators - triangular, saw tooth, square wave
UNIT IV
Specialized IC Applications : Introduction to 555 timer, functional diagram, Monostable and Astable operations and applications, Schmitt Trigger, PLL-Introduction, block

schematic, principles and description of individual blocks of 565, Fixed and variable voltage regulators
UNIT V
Data Converters: Introduction, Basic DAC techniques, Different types of DACs-Weighted resistor DAC,R-2R ladder DAC, Inverted R-2R DAC. Different Types of ADCs –flash Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications

Suggested Text Books:
1. Ramakanth A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson, 4/e, 2018.
2. D. Roy Chowdhury – Linear Integrated Circuits, New Age International(p)Ltd,2nd Edition., 2003
3. John. F. Wakerly – Digital Design Principles and Practices, 3rd Ed., Pearson, ,2009.
Reference Text Books:
1. R.F. Coughlin & Fredrick F. Driscoll, "Operational Amplifiers & Linear Integrated Circuits, , PHI Publications 2002
2. Salivahana -Linear Integrated Circuits and Applications, TMH, 2008.
3. William D.Stanley- Operational Amplifiers with Linear Integrated Circuits, 4th Ed., Pearson Education India, 2009.

Course Code	**Course Title**						**Core/PE/OE**
25PC255EC	**COMMUNICATION SYSTEMS LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC205EC	**-**	**-**	**-**	**2**	**40**	**60**	**1**
Course Objectives : The course is taught with the objectives of enabling the student to:							
1. To demonstrate AM and FM modulation and demodulation techniques.							
2. To understand pulse modulation techniques such as PAM, PWM and PPM							
3. To understand digital modulation (i.e. ASK, FSK, BPSK) generation and detection.							

4. To model analog and pulse modulation techniques using CAD tools.
5. To model PCM, Delta modulation and digital modulation techniques using CAD tools.
Course Outcomes : On completion of this course, the student will be able to :
1. Understand and simulate modulation and demodulation of AM.
2. Understand and simulate modulation and demodulation of FM.
3. Simulate the PAM, PWM & PPM circuits.
4. Understand generation and detection of PCM and DM.
5. Understand generation and detection of ASK, FSK and PSK.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2	2	1	-	1	1	3	1	3	-	3	–
CO2	3	3	3	2	2	1	-	1	1	3	1	3	–	3	–
CO3	3	2	3	2	3	1	-	1	1	3	1	3	–	3	–
CO4	3	3	3	2	3	1	-	1	1	3	1	3	–	3	–
CO5	3	3	3	2	2	1	-	1	1	3	1	2	–	2	–

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments
PART A
1. Amplitude Modulation and Demodulation.
2. Frequency Modulation and Demodulation.
3. Verification of Sampling Theorem.
4. PAM generation and detection
5. PWM and PPM generation and detection
6. Generation and Detection of AM and FM usingMATLAB / Simulink / Lab-view
7. Generation and Detection of PAM, PWM and PPM usingMATLAB / Simulink / Lab-view
PART B
1. PCM modulation and demodulation.
2. Linear and Adaptive Delta Modulation and Demodulation.
3. ASK generation and Detection.
4. FSK generation and Detection.
5. PSK generation and Detection.
6. Generation and Detection of PCM and Delta modulation schemes usingMATLAB / Simulink / Lab-view
7. Generation and Detection of Digital modulation schemes (ASK, FSK and PSK) usingMATLAB / Simulink / Lab-view

Note : A minimum of 10 experiments should be performed with at least 5 from each section

Suggested Text Books:
1. Communication systems by V.ChandraSekar,SASTRAUniversity, Oxford UniversityPress,2013,ISBN:9780198078050

2. Digital Communication Systems Using MATLAB and Simulink, Second Edition byDennis Silage 2020.

Course Code	Course Title						Core/PE/OE
25PC256EC	**SIGNALS AND CONTROL SYSTEMS LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC206EC, 25PC208EC	**-**	**-**	**-**	**2**	**40**	**60**	**1**
Course Objectives : The course is taught with the objectives of enabling the student to:							

1.	Familiarize students with MATLAB for modeling, generation, and analysis of continuous- and discrete-time signals and systems.
2.	Perform signal processing operations and analyze system properties using MATLAB
3.	Develop the ability to analyze signals in the frequency domain using Fourier and Laplace transforms and to verify the Sampling Theorem.
4.	Provide practical knowledge of time-domain and frequency-domain analysis of second-order control systems using MATLAB.
5.	Develop the ability to analyze system stability and design compensators using Root Locus, Bode, Nyquist plots, and Lead/Lag compensators in MATLAB
	Course Outcomes : On completion of this course, the student will be able to :
1.	Generate and manipulate continuous- and discrete-time signals and perform fundamental signal operations using MATLAB
2.	Analyze system properties, perform convolution, evaluate signal characteristics, and verify the Sampling Theorem using MATLAB.
3.	Analyze Fourier and Laplace transforms of signals and interpret their magnitude and phase spectra using MATLAB
4.	Analyze the time response, frequency response, and stability characteristics of second-order control systems using MATLAB.
5.	Design and analyze Lead and Lag compensators and evaluate control system performance using MATLAB.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	–	–	–	–	–	1	3	–	2	–
CO2	3	2	3	2	3	–	–	–	–	–	1	3	–	3	–
CO3	3	2	3	2	3	–	–	–	–	–	1	3	–	3	–
CO4	3	2	3	2	3	–	–	–	–	–	1	3	–	2	–
CO5	3	2	2	2	3	–	–	–	–	–	1	2	–	2	–

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments
PART A
1. Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp
2. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power
3. Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal
4. Convolution between Signals and sequences
5. Verification of Linearity and Time Invariance Properties of a given Continuous/Discrete System.
6. Find the Fourier Transform & Laplace of a given signal and plotting its magnitude and phase spectrum
7. Verification of Sampling Theorem.
PART B
1. Analyze the time response characteristics of second-order systems using
2. analyze the frequency response characteristics of second-order systems
3. Plot and analyze the Root Locus of control systems using
4. Draw &analyze the Bode plot of control systems

5.	Plot and analyze the Nyquist characteristics of control systems
6.	Design and analyze Lead a compensators
7.	Design and analyze Lead a compensators

Note :Students are required to perform minimum 10 experiments, 5 experiments from Part A and 5 experiments Part B using MATLAB

Suggested Text Books:
1. B.P.Lathi,LinearSystemsandSignals,OxfordUniversityPress,2nd Edition,2009
2. Nagrath, I.J, and Gopal, M., "Control System Engineering", 5th edition, New Age Publishers, 2009

Course Code	**Course Title**						**Core/PE/OE**
25PC257EC	**LINEAR IC APPLICATIONS LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			
25PC251EC	**-**	**-**	**-**	**2**	**40**	**60**	**1**
Course Objectives : The course is taught with the objectives of enabling the student to:							

1. Understand the characteristics and applications of operational amplifiers through experimental verification
2. Design and analyze Op-Amp-based linear circuits such as amplifiers, filters, comparators Schmitt triggers, and precision rectifiers.
3. Design and analyze Op-Amp-based linear circuits such as Schmitt triggers, and precision rectifiers
4. Verify the frequency of oscillation and study the effect of RC network parameters on the output frequency.
5. Implement timer circuits and data converters using IC 555 and R-2R ladder DAC
Course Outcomes : On completion of this course, the student will be able to :
6. Design and verify the characteristics of Op-Amp circuits including inverting, non-inverting, voltage follower, adder, subtractor, integrator, and differentiator
7. Design and analyze Op-Amp applications such as active filters, comparators
8. Design and analyze Op-Amp applications such as Schmitt triggers, and precision rectifiers
9. Design and implement an RC phase shift oscillator using an Op-Amp
10. Implement and verify the operation of monostable and astablemultivibrators using IC 555 and analyze the R-2R ladder DAC.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	3	–	–	–	–	–	2	–	1	3	3
CO2	3	3	2	2	3	–	–	–	–	–	2	–	2	3	3
CO3	3	3	1	2	3	–	–	–	–	–	2	–	1	3	3
CO4	3	3	2	2	3	–	–	–	–	–	2	–	3	3	3
CO5	3	3	3	2	3	–	–	–	–	–	2	–	3	3	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

PART A
1. Design and verify the characteristics of inverting, non-inverting and voltage follower using Op-Amp.
2. Design Adder and Subtractor using Op Amp and verify addition and subtraction process
3. Design and verify the characteristics of Op-Amp based integrator and differentiator circuits
4. Design and verify the characteristics of active low-pass, high-pass, and band-pass filters using Op-Amp.
5. Construct and analyze a Schmitt trigger using Op-Amp to understand hysteresis and waveform shaping.
6. Construct and analyze Precision half wave & full wave Rectifier Circuits using IC 741
7. Design and Realization of Op-Amp based Astable multivibrator for Square wave generation
PART B
1. Design, Realization and plot the frequency response of First order Low pass and High pass filters using Op-Amp
2. Design and plot the frequency response of Band pass filter using Op-Amp.
3. Design and Realization of RC phase shift Oscillator for sinusoidal signal generation using Op-Amp
4. .Design and Realization of Function generator for square wave and triangular waves using

	Op-Amps
5.	Design and verify the characteristics monostablemultivibrator circuit using the NE555 timer IC
6.	Design and verify the characteristics astablemultivibrator circuit using the NE555 timer IC
7.	Implement and analyze R-2R ladder DAC

Note : A minimum of 10 experiments should be performed with at least 5 from each section

Suggested Text Books:	
1.	D.Roy Chowdhury, ShailB.Jain, “Linear Integrated Circuits”, 4/e, New Age International (P) Ltd., 2008.
2.	Ramakanth A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, Pearson, 4/e, 2018.

MUFFAKHAM JAH COLLEGE OF ENGINEERING & TECH NOLOGY (A)

SCHEME OF INSTRUCTION & EXAMINATION w.e.f. Academic Year 2026-27

SERVICE COURSES

B.E. (CSE)

SEMESTER-1II			Scheme of Instruction				Scheme of Examination			Credits
S. No	**Course Code**	**Name of the Course**	**Lecture**	**Tutorial**	**Practical**	**Contact**	**CIE**	**SEE**	**Duration**	
1	25ES211EC	Integrated Electronics	3	-	-	3	40	60	3	3
2	25ES251EC	Integrated Electronics Lab	-	-	2	2	40	60	3	1
		Total	**3**	**-**	**2**	**5**	**80**	**120**	**6**	**4**

B.E. (Civil, Mechanical, CSE(AI), CSE(AIML), CSE(DS))

SEMESTER-1II			Scheme of Instruction				Scheme of Examination			Credits
S. No	**Course Code**	**Name of the Course**	**Lecture**	**Tutorial**	**Practical**	**Contact**	**CIE**	**SEE**	**Duration**	
1	25SD254EC	Skill Development Course: IOT	-	-	2	2	50	-	-	1
		Total	-	-	2	2	50	-	-	1

B.E. (CSE)

SEMESTER-1V			Scheme of Instruction				Scheme of Examination			Credits
S. No	**Course Code**	**Name of the Course**	**Lecture**	**Tutorial**	**Practical**	**Contact**	**CIE**	**SEE**	**Duration**	
1	25SD254EC	Skill Development Course: IoT	-	-	2	2	50	-	-	1
		Total	-	-	2	2	50	-	-	1

Course Code	**Course Title**						**Core/PE/OE**
25ES251EC	**INTEGRATED ELECTRONICS LAB**						**Core**
	Contact Hours per Week				**CIE**	**SEE**	**Credits**
Prerequisite	**L**	**T**	**D**	**P**			

25ES201EC	-	-	-	2	40	60	1

Course Objectives: The course is taught with the objectives of enabling the student to:
1. To understand the characteristics of diodes and transistor configurations.
2. To understand the design concepts of BJT and FET configurations.
3. To understand and verify the functionality of basic logic gates and standard combinational logic circuits.
4. To design and realize combinational circuits using universal gates, multiplexers, and decoders.
5. To verify and analyze the operation of various flip-flops, design and simulate digital circuits.
Course Outcomes : On completion of this course, the student will be able to :
1. Design diode circuits & understand the application of Zener diode.
2. Analyze characteristics of BJTs & FETS.
3. Verify the truth tables of basic logic gates and implement simple code converters using logic gates.
4. Design and implement half and full adders/ subtractors using universal gates, MUX, and decoders.
5.Analyze the working of different flip-flops and simulate combinational circuits.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	3	2	–	–	–	–	1	2
CO2	3	3	3	3	2	–	–	–	–	1	2
CO3	3	2	3	2	3	–	–	–	1	1	2
CO4	3	2	3	2	3	–	–	–	1	1	2
CO5	3	2	3	2	3	–	–	–	1	2	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments: PART A
1. Characteristics of Semiconductor diode Silicon Germanium and Zener.
2.Full-wave rectifier with and without filter
3.Zener diode as a voltage regulator.
4. Static Characteristics of BJT-Common Emitter
5. Static Characteristics of FET.
List of Experiments: PART B
1. Verification of truth tables of Logic gates and realization of Binary to Gray and Gray to Binary code converters.
2. Realization of Half adder/ subtractor using universal logic gates.
3. Realization of Full adder/ subtractor using universal logic gates.
4. Realization of Full adder/Sub using MUX and Decoder
5. Verification of truth tables of Flip Flops.
6. Design and simulation of basic logic gates and verification of their truth tables.
7.Design and simulation of Combinational circuits such as adders, subtractors, multiplexers, and demultiplexers

Note: The Preferred Simulation Tools are LTspice – for analog circuit simulation, Multisim /PSpice – for analog and mixed-signal circuit simulation, Logisim – for basic digital logic circuits.

Suggested Text Books:
1. David A. Bell, Lab Manual for Electronic Devices and Circuits, 4th Edition, PHI.
2. Zbar, Malvino, Miller, Basic Electronics: A Text Lab Manual.
3. M. H. Rashid, SPICE for Circuits and Electronics Using PSpice, Pearson.
4. A. Sudhakar and Shyammohan S. Palli, Circuits and Networks: Analysis and Synthesis, McGraw Hill Education.

Note:-Minimum four experiments from Part A and Minimum Six from Part B must be covered.

Course Code	Course Title	Core/PE/OE

25ES211EC	INTEGRATED ELECTRONICS						Core
	Contact Hours per Week				CIE	SEE	Credits
Prerequisite	L	T	D	P			
25BS102PH	3	-	-	-	40	60	3

Course Objectives : The course is taught with the objectives of enabling the student to:

1. Understand the characteristics of diodes and its applications.
2. Understand the configurations and characteristics of BJT and FET.
3. Understand the fundamental principles of digital hardware design and number systems.
4. Apply Boolean algebra and logic minimization techniques to implement combinational circuits efficiently.
5. Explore the architecture and design methodologies using programmable logic devices like PALs, PLAs, CPLDs, and FPGAs

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

1. Study and analyze the rectifiers and regulator circuits.
2. Study and analyze the performance of BJTs, FETs on the basis of their operation and working.
3. Explain the fundamentals of digital hardware design, logic gates, Boolean algebra and K-map.
4. Design combinational circuits and memory elements.
5. Implement combinational logic using PLDs such as PALs, PLAs, CPLDs, and FPGAs.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	1	–	–	–	–	–	1
CO2	3	3	2	2	1	–	–	–	–	–	1
CO3	3	2	3	2	2	–	–	–	1	1	2
CO4	3	2	3	2	2	–	–	–	1	1	2
CO5	3	2	2	2	3	–	–	–	1	2	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT I

Introduction to Semiconductor Diodes: Formation of PN junction, V-I characteristics of PN junction diode. Half-wave rectifier, Full-wave rectifier, performance parameters—Peak Inverse Voltage (PIV), ripple factor, rectification efficiency, introduction to filter circuits (capacitor, inductor and π-filters). Applications of diodes. **Voltage Regulation:**Zener diode characteristics, Zener diode as a voltage regulator.

UNIT II

Bipolar Junction Transistor: BJT construction and working, modes of operation, configurations of BJT (CB, CE, CC). Junction Field Effect Transistor: Construction and working of JFET, V-I characteristics of JFET.

UNIT III

Number Systems and Combinational Logic Fundamentals: Number systems and codes. Introduction to logic circuits – Variables and functions, Logic gates and networks. Boolean algebra, Design Examples Using Logic Gate. Optimized implementation of logic functions using K-Map.

UNIT IV

Combinational Circuit Design and Flip-Flops: Adders, Subtractors, Multiplexers,

Demultiplexers, Decoders, Encoders and Code converters: Binary to Gary, Gray to Binary and BCD to seven segments, Introduction to sequential circuit, Memory elements: Basic Latch, Gated SR Latch, gated D Latch, T Flip-flop and JK Flip-flop.
UNIT V
Design of combinational circuits using Programmable Logic Devices (PLDs): General structure of a Programmable Array Logic (PAL), Programmable Logic Arrays (PLAs), Structure of CPLDs and FPGAs, 2-input and 3-input lookup tables (LUTs).

Suggested Text Books:
1. Robert Boylestad L. and Louis Nashelsky, Electronic Devices and Circuit Theory, PHI,2007. 2 st Edition, Prentice Hall of India, 2006.
2. Morris Mano and Michael D. Ciletti, “Digital Design”, Pearson, 6/e, 2021.
3. ZviKohavi, “Switching and Finite Automata Theory”, 3/e, Cambridge University Press New Delhi, 2011
Reference Text Books:
1. **John F. Wakerly**, *Digital Design: Principles and Practices*, 5th Edition, Pearson Education, 2018.
2. **Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss**, *Digital Systems: Principles and Applications*, 12th Edition, Pearson Education, 2016.
3. Basic electronics by J B Gupta

Course Code	Course Title						Core/PE/OE
25SD254EC	SKILL DEVELOPMENT COURSE: IOT						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	50	-	1

Course Objectives : The course is taught with the objectives of enabling the student to:

1. Understand the fundamentals of embedded IoT systems by interfacing sensors, actuators, and peripheral devices using ESP32/Arduino/Raspberry Pi.
2. Develop embedded programs to acquire, process, and display sensor data using appropriate programming techniques and hardware interfaces.
3. Implement wireless communication protocols and cloud platforms for remote monitoring and control of IoT devices.
4. Design IoT-based applications by integrating hardware, networking, cloud services, and mobile/web interfaces to solve real-world engineering problems.
5. Develop teamwork, problem-solving, and project implementation skills through the design and realization of an end-to-end IoT system.

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

1. Interface and program digital input/output devices, sensors, actuators, and display modules using ESP32/Arduino/Raspberry Pi.
2. Acquire, process, and display sensor data using embedded programming and hardware interfacing techniques.
3. Develop wireless IoT applications using Bluetooth and Wi-Fi for remote monitoring and control.
4. Implement cloud-based IoT applications for sensor data acquisition, visualization, and remote device management.
5. Design and demonstrate an end-to-end IoT application by integrating embedded hardware, communication, cloud, and user interfaces.

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

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

List of Experiments

1. Interface an LED with ESP32/Arduino/Raspberry Pi and write a program to blink the LED using digital output.
2. Interface a Push Button with ESP32/Arduino/Raspberry Pi and write a program to control an LED based on the button state.
3. IR/LDR Sensor Interfacing: Interface an IR or LDR sensor with ESP32/Arduino/Raspberry Pi and write a program to detect an object/light intensity and control an LED accordingly.
4. Interface a 16×2 LCD (I2C) with ESP32/Arduino/Raspberry Pi and write a program to display text and sensor readings.
5. Interface a DHT11 Temperature and Humidity Sensor with ESP32/Arduino/Raspberry Pi and

	display the measured values on the Serial Monitor/LCD.
6.	Interface a Relay Module with ESP32/Arduino/Raspberry Pi and write a program to control a DC motor or AC load using a push button or sensor input.
7.	Develop a Bluetooth Low Energy (BLE) or Bluetooth Serial application using ESP32 to control an LED or relay from a smartphone.
8.	Interface an HC-SR04 Ultrasonic Sensor with ESP32/Arduino/Raspberry Pi and measure the distance to an object. Display the measured distance on the Serial Monitor/LCD.
9.	Acquire temperature and humidity data from the DHT11 sensor using ESP32 and upload the sensor readings to the ThingSpeak Cloud. Visualize and analyze the data using ThingSpeak charts.
10.	Develop a mobile-based IoT application using ESP32 to remotely monitor temperature and humidity and control an LED or relay through the Blynk IoT mobile dashboard.
11.	Develop an embedded web server on ESP32 to monitor sensor data and control an LED/relay through a web browser over a Wi-Fi network.

Mini Project:

- Students shall implement a complete domain-specific IoT application (Smart Home, Smart Agriculture, Smart Energy Monitoring, Smart Environment Monitoring, Smart Healthcare, etc.) using ESP32/Arduino/Raspberry Pi, integrating sensors, actuators, wireless communication, and cloud/mobile monitoring.

Suggested Text Books:

Reference Books

1. Michael Margolis – *Arduino Cookbook*
2. Simon Monk – *Programming Arduino: Getting Started with Sketches*
3. John Boxall – *Arduino Workshop*
4. Neil Cameron – *ESP32 Essentials*
5. Simon Monk – *Programming the Raspberry Pi: Getting Started with Python*

Online Resources

1. ThingSpeak Documentation: https://www.mathworks.com/help/thingspeak/
2. Blynk IoT Documentation: https://docs.blynk.io/
3. Arduino Documentation: https://docs.arduino.cc/
4. Arduino-ESP32 Documentation: https://docs.espressif.com/projects/arduino-esp32/
5. ESP-IDF Documentation: https://docs.espressif.com/projects/esp-idf/
6. Raspberry Pi Documentation: https://www.raspberrypi.com/documentation/