ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES (A)
(UGC Autonomous)
Approved by AICTE, Affiliated to Andhra University, Accredited by
(Estd : 2001)

2023- 24

Academic Regulations (R23-ECE) Curriculum & Syllabi

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

R23 2nd Year Course Structure
Electronics and Communication Engineering

II Year Course structure										
Semester - I										
Course Code	**Title of the course**	**Category**	**Periods**				**Sessionals Marks**	**Semester end Exam marks**	**Total Marks**	**Credits**
			L	**T**	**P**	**Total**				
23MA1104	**Vector Calculus and Transform Techniques**	**BS**	**3**	**-**	**-**	3	40	60	100	**3**
23EC4102	**Random Variables& Stochastic Process**	**PC**	**3**	**-**	**-**	3	40	60	100	**3**
23EC4103	**Signals and Systems**	**PC**	**3**	**-**	**-**	3	40	60	100	**3**
23EE4117	**Control Systems**	**PC**	**3**	**-**	**-**	3	40	60	100	**3**
23EC4105	**Analog Electronic circuits**	**PC**	**3**	**-**	**-**	3	40	60	100	**3**
23EC4201	**Signals and Systems Lab**	**PC**	**-**	**-**	**3**	3	50	50	100	**1.5**
23EC4202	**Analog Electronic circuits Lab**	**PC**	**-**	**-**	**3**	3	50	50	100	**1.5**
23EC9201	**Skill Oriented Course* (JAVA Programming)**	**SC**	**-**	**-**	**3**	3	50	50	100	**1.5**
23CR9101	**Logical Reasoning and Corporate skills**	**HS**	**-**	**-**	**2**	2	50	0	50	**1**
23MC0104	**Entrepreneurship & IPR**	**MC**	**2**	**-**	**-**	2	50	0	50	**-**
Total			**17**	**-**	**17**	**0**	**11**	**28**	**900**	**20.5**

R23 2nd Year Course Structure
Electronics and Communication Engineering

Semester - II										
Course Code	Title of the course	Category	Periods				Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	Total				
23MA1108	Complex Variables and Partial Differential Equations	BS	3	-	-	3	40	60	100	3
23EC4107	Linear & Digital IC Applications	PC	3	-	-	3	40	60	100	3
23EC4108	Analog & Digital Communications	PC	3	-	-	3	40	60	100	3
23EC4109	Electromagnetic Waves& Transmission Lines	PC	3	-	-	3	40	60	100	3
23ME3203	Design Thinking	ES	2	-	-	2	40	60	100	2
23EC3105	Python Programming for Engineers	ES	3	-	-	3	40	60	100	3
23EC4205	Analog & Digital Communication Lab	PC	-	-	3	3	50	50	100	1.5
23EC4206	Linear & Digital IC Applications Lab	PC	-	-	3	3	50	50	100	1.5
23EC9202	Skill Oriented Course* (Design through Verilog)	SC	-	-	3	3	50	50	100	1.5
23CR9102	Numerical Ability and Professional Communication	HS	-	-	2	2	50	0	50	1
23MC0103	Financial Literacy	MC	2	-	-	2	50	0	50	-
Total			19	-	19	0	11	30	1000	22.5

VECTOR CALCULUS & TRANSFORM TECHNIQUES
(Common to ECE and EEE)

23MA1104 **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40
End Exam : 3 Hours End Exam Marks:60

Prerequisites: Differentiation, integration and functions.

Course Objectives:
The aim of this course is to introduce basic fundamentals of vector calculus, and study of Fourier and Z-transforms and its applications.

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

1.	Examine, analyze and compare probability distributions**.**
2.	Identify different Fourier transforms of non-periodic functions and also use them to evaluate boundary value problems.
3.	Explain the characteristics and properties of Z-transforms.
4.	Explain the characteristics of scalar and vector valued functions and provide a physical interpretation of the gradient, divergence, curl and related concepts.
5.	Transform line integral to surface integral, surface to volume integral and vice versa using Green's theorem, Stoke's theorem and Gauss's divergence theorem.

CO-PO –PSO Mapping:

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

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO1 deals with knowledge of probability distributions and is widely used in many areas of engineering.
2	CO2 deals with properties of Fourier transforms, and their applications, these are widely used in various field of engineering.
3	CO3 deals with the properties and applications of Z-transforms, there are used to analyze process digital data in various filed of electrical engineering.
4	CO4 deals with finding the gradient, div and curl of a given vector point functions and these fundamental concepts in vector calculus are widely used in many areas of engineering.
5	CO5 deals with vector integration like line, surface and volume integrals and these are widely used in various fields of engineering.

SYLLABUS

UNIT I **10 Periods**

PROBABILITY AND DISTRIBUTIONS

Introduction – Basic terminology – Probability and set notations – Addition law of probability – Independent events – Baye's theorem – Random variable – Discrete probability distribution: Binomial distribution – Continuous probability distributions: Poisson distribution and normal distribution (mean , variance , standard deviation and their properties without proofs).

UNIT II **10 Periods**

FOURIER TRANSFORMS

Introduction – Definition – Fourier integral theorem (without proof) – Fourier sine and cosine integrals – Fourier transforms – Properties of Fourier transforms – Convolution theorem – Parseval's identity for Fourier transforms – Relation between Fourier and Laplace transforms – Fourier transforms of the derivatives of a function – Applications of transforms to boundary value problems.

UNIT III **10 Periods**

Z-TRANSFORMS

Introduction – Definition - Some standard Z-transforms – Linearity property – Damping rule – Some standard results – Shifting U_n to the right/left – Multiplication by n – Two basic theorems (Initial value theorem and Final value theorem) – Convolution theorem.

Evaluation of inverse Z - transforms – Applications to difference equations.

UNIT IV **10 Periods**

VECTOR DIFFERENTIATION

Scalar and vector point functions – Del applied to scalar point functions – Directional derivative – Del applied to vector point functions – Physical interpretation of divergence and curl – Del applied twice to point functions – Del applied to products of point functions.

UNIT V **10 Periods**

VECTOR INTEGRATION

Integration of vectors – Line integral , circulation, work done – Surface integral , flux – Green's theorem in the plane – Stoke's theorem – Volume integral – Gauss divergence theorem (all theorems without proofs) – Irrotational and solenoidal fields.

TEXT BOOKS:

B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1. **Erwin Kreyszig**, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. **N. P. Bali**, Engineering Mathematics, Lakshmi Publications.
3. **George B. Thomas, Maurice D. Weir and Joel Hass**, Thomas, Calculus, 13/e, Pearson Publishers, 2013.
4. **H. K. Dass**, Advanced Engineering Mathematics, S. Chand and complany Pvt. Ltd.
5. **Michael Greenberg**, Advanced Engineering Mathematics, Pearson, Second Edition.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Random Variables & Stochastic Process	
Code: 23EC4102	**Credits:3**
Instruction: 3 Periods & 1 E/Week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Pre -requisites: Basic of Probability Theory

Course Objectives:

- To know some important operations to perform on a random variable / multiple random variables.
- To understand the mathematical concepts and analysis of random processes with its basic applications to the engineering, finance and computer science.

Course Outcomes:

By the end of the course student will be able to

CO	BL	CO Statement
CO1	BL-1, 2,3	Compute statistical averages of one random variable using probability density and distribution functions and also transform random variables from one density to another
CO2	BL-3	Compute statistical averages of two or more random variables using probability density and distribution functions and also perform multiple transformations of multiple random variables.
CO3	BL-3	Determine stationarity and ergodicity and compute correlation and covariance of a random process.
CO4	BL-2,3	Compute and sketch the power spectrum of the response of a linear time-invariant system excited by a band pass/band-limited random process.
CO5	BL-4	Apply Markov Chains to model and analyze various stochastic processes such as random walks

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2												2	
2	3	2												2	
3	3	2										1		2	
4	3	2										1	1	2	
5	3	2										1	1	2	

SYLLABUS

UNIT-I RANDOM VARIABLES 12 periods

Random Variable: Definition, Types, Conditions for a Function to be a Random Variable,

Distribution & Density Functions: Definitions, Properties; Binomial, Poisson, Uniform, Gaussian, Exponential, and Rayleigh distributions, Conditional Distributions & density.

Operation on One Random Variable: Expected Value of a Random Variable, Function of a Random Variable, Moments and Variance, Chebyshev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations

Computer Simulation of Real-world problems: Servicing Customers, Data Compression, Setting clipping levels, Critical software testing

UNIT-II MULTIPLE RANDOM VARIABLES AND OPERATIONS 10 periods

Multiple Random Variables: Vector Random Variables, Joint Distribution Function and its Properties, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Interval conditioning, Statistical Independence, Sum of Two Random Variables.

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case.

Computer Simulation of Real-world problems: Assessing health risk, Retirement planning, Signal Detection, Opinion polling

UNIT-III RANDOM PROCESS – TEMPORAL CHARACTERISTICS 10 periods

Introduction, The Random Process Concept: Classification of Process, Deterministic and Nondeterministic Process. Stationarity and Ergodicity, Correlation Functions: Autocorrelation Functions and Its Properties, Cross-correlation Functions and its properties, Covariance Functions, Discrete-Time Process and Sequences, Gaussian Random Process, Poisson Random Process.

Computer Simulation of Real-world problems: Analyze the stationarity of the sales data and calculate its autocorrelation function.

UNIT-IV SPECTRAL ANALYSIS 9 periods

The Power Spectrum: Relationship between Power spectrum and Autocorrelation, Relationship between Cross Power spectrum and Cross-correlation, White and Colored Noise, Product device response to a random signal.

Linear System: Random signal Response of Linear system, Spectral characteristics of system response, Noise Bandwidth, Band pass, Band Limited and Narrowband Process. Rice's Representation.

Computer Simulation of Real-world problems: power spectrum of this random process representing the fluctuations in stock prices over time.

UNIT-V MARKOV CHAIN 9 periods

Introduction to Random walk and Random chain, Chapman–Kolmogorov Equations, Classification of States, Limiting Probabilities, Some Applications: The Gambler's Ruin

Problem, A Model for Algorithmic Efficiency.

Computer Simulation of Real-world problems: a simple random walk in one dimension, The transition probabilities between states.

TEXT BOOKS:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4Ed., McGraw Hill, 2001.
2. Sheldon M. Ross, "Introduction to Probability Models", 10th Edition, Academic Press Elsevier, 2010.
3. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw Hill, 2002.

REFERENCE BOOKS:

1. S. P. Eugene Xavier, "Probability Theory and Random Processes", (2nd Edition).S. Chand and Co. New Delhi, 1998
2. Henry Stark & John W. Woods, "Probability, Statistics, and Random Processes for Engineers", 4Ed, Pearson, 2012
3. Davenport W. B. Jrs. and W. I. Root, "Introduction to Random Signals and Noise", McGraw Hill N.Y., 1954
4. Dr.P.Srihari, "Probability Theory & Stochastic Process", 3rd edition, Hi-Tech Publishers, 2010

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SIGNALS AND SYSTEMS (Common to ECE, EEE)	
Code: 23EC4103	**Credits:3**
Instruction: 3 Periods & 1 E/Week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Pre -requisites: Fourier Series, Laplace Transform, Z-transform

Course Objectives:

- Understand the fundamental characteristics of Signals and Systems.
- Understand signals and systems characteristics, and its analysis in both the time and frequency domains.
- Understand significance of sampling and correlation concepts of signal processing.
- Development of the mathematical skills to solve problems of basic signal processing such as convolution, correlation, sampling etc.

Course Outcomes:

By the end of the course student will be able to

CO	BL	CO Statement
CO1	BL-1, 2	Differentiate various signal functions & systems.
CO2	BL-4	Analyze LTI system characteristics in time domain.
CO3	BL-4	Analyze continuous-time signal characteristics in time and frequency domains.
CO4	BL-2	Demonstrate the requirement of sampling and correlation concepts.
CO5	BL-4	Analyze discrete-time signal characteristics in time and frequency domains.

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO	PO												PSO			Justification
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	2	1	-		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1
2	2	1	1		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 3.1.1, PI 5.1.1, PI 12.1
3	2	1	1		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 3.1.1, PI 5.1.1, PI 12.1
4	2	1			1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1
5	2	1			1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1

SYLLABUS

Note: All MATLAB Simulations in the syllabus are meant for only teaching purpose and ***NOT*** for ***Final examination***.

UNIT-I INTRODUCTION 10 periods

Introduction to Continuous-time and Discrete-time Signals: Representation, Elementary signals, Basic operations, Classifications.

Introduction to Continuous-time and Discrete-time Systems: Definition & representation, Classifications.

MATLAB Simulation*:** Signals generation & operations**,** basic system modelling using ***Simulink.

UNIT-II TIME DOMAIN ANALYSIS OF SYSTEMS 12 periods

Time domain analysis of Continuous-time Systems: Representation of a continuous time signals, Impulse response, Convolution- graphical procedure, properties, Causality, Stability, Step response.

Time domain analysis of Discrete-time Systems: Representation of a discrete time signals in terms of impulses, Impulse response, Convolution - graphical & Matrix procedure, properties; Causality, Stability, and Step response.

***MATLAB Simulation*:** Continuous time and Discrete time Convolution Operations.

UNIT-III ANALYSIS OF CONTINUOUS TIME SIGNALS 14 periods

Fourier Series analysis of periodic Signals: Analysis using Trigonometric & Exponential Fourier Series; Gibb's Phenomenon.

Fourier Transform: Fourier Transform of periodic signals**,** properties, Inverse Fourier Transform, System analysis using Fourier transform.

Laplace Transform: Region of Convergence (ROC), properties, Inversion of unilateral and Bilateral Laplace transforms, Analysis of electrical networks using Laplace Transform.

***MATLAB Simulation*:** Arbitrary shape/signal generation using Fourier Series, Gibb's Phenomenon, Frequency analysis of audio signals.

UNIT-IV 12 periods

Sampling: Sampling Theorem & it's Graphical and analytical proof for band limited signals, Types of sampling, Reconstruction of signal from its samples, Effect of under sampling - Aliasing; Introduction to band pass signals sampling theorem.

Correlation: Correlation of discrete time sequence, Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation.

***MATLAB Simulation*:** Sampling Theorem verification, Effect of under sampling, correlation.

UNIT-V ANALYSIS OF DISCRETE TIME SIGNALS 12 periods

Discrete-time Fourier Series (DTFS), Discrete-time Fourier Transform (DTFT).

Z-Transform: Region of Convergence (ROC), properties, Inverse Z-Transform. Relation between Z-Transform & DTFT, Relation between s-plane & z-plane, stability criterion, Deconvolution using Z-Transform.

***MATLAB Simulation*:** Computation of DTFT, Z-Transform and Inverse Z-Transform.

TEXT BOOKS:

1. A.V. Oppenheim, AS Willsky and S.H. Nawab, " Signals and Systems", Pearson.
2. S.Haykin and B.V Veen, "Signals and Systems", John Wiley.
3. Ramesh Babu and R. Anandanatarajan, "Signals and Systems" 4/e, Scitech

REFERENCE BOOKS:

1. E.W Kamen and B.S.Heck, "Fundamentals of Signals and Systems", using the Web and MATLAB,Pearson.
2. Luis F. Chaparro and Aydin Akan, "Signals and Systems Using MATLAB", 3rd Edition. 2019, Academic Press is an imprint of Elsevier.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CONTROL SYSTEMS (ECE)	
Code: 23EE4117	**Credits:3**
Instruction: 3 Periods & 1 E/Week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Course Outcomes:

By the end of the course student will be able to

CO 1	BL 3	**Apply** signal flow graph and block diagram reduction techniques to **Develop** Transfer function for Linear time invariant systems.
CO 2	BL 3	**Apply** the relationship between the variables of electrical and mechanical systems to **Develop** mathematical models of electrical and mechanical systems.
CO 3	BL 4	**Analyze** the performance of 1^{st} and 2^{nd} order Linear time invariant systems with and without feedback control to **Determine** time domain specifications and error for standard inputs.
CO 4	BL 4	**Apply** Routh-Hurwitz criterion and Root locus technique to **Analyze** the stability for LTI systems in time domain frame.
CO 5	BL 4	**Apply** bode, polar and Nyquist plots to **Analyze** the stability for LTI systems in frequency domain frame.

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

	Program Outcomes (POs)												**PSOs**	
COs	**Domain Specific Pos**					**Domain Independent Pos**								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	3	3	1	1	1	-	-	-	-	-	-	2	-	2
CO 2	3	3	2	-	2	-	-	-	-	-	-	2	-	2
CO 3	2	2	3	1	2	-	-	-	-	-	-	2	-	2
CO 4	2	2	3	-	2	-	-	-	-	-	-	2	-	2
CO 5	2	2	3	-	2	-	-	-	-	-	-	2	-	2

JUSTIFICATION STATEMENT FOR CO-PO MAPPING

COs	Pos	Level	Description
CO1	**PO1**	**L3**	The transfer functions of electrical systems are calculated using BDR and SFG techniques with the fundamental knowledge of basic electrical engineering and mathematics.
CO1	**PO2**	**L3**	Transfer function is obtained by applying principles of mathematics and electrical engineering
CO1	**PO3**	**L1**	Develop a block diagram and signal flow graph for a given electrical system
CO1	**PO4**	**L1**	Investigation is performed on block diagram of a electrical system to obtain the transfer function
CO1	**PO5**	**L1**	Using MATLAB, we can obtain the transfer function of given block diagram of a system.
CO1	**PO12**	**L2**	Apply these methods of finding transfer functions to real time applications.
CO2	**PO1**	**L3**	Find the transfer function of given mechanical system using basic principles of engineering mathematics
CO2	**PO2**	**L3**	Modeling of electrical system from mechanical system (vice versa) using principles of engineering sciences
CO2	**PO3**	**L2**	To develop complex electrical system from mechanical system using analogy techniques.
CO2	**PO5**	**L2**	Modeling of electrical and mechanical systems using simulation software.
CO2	**PO12**	**L2**	Modeling using analogy techniques can be applied to electro-mechanical systems
CO3	**PO1**	**L2**	To obtain responses of given system by applying the knowledge of engineering mathematics
CO3	**PO2**	**L2**	To determine error constants and steady state error of given system by applying mathematical and electrical engineering knowledge
CO3	**PO3**	**L3**	Design of PI, PD, PID controller for a given system to meet the required performances.
CO3	**PO4**	**L1**	To analyze the time domain specification for a complex problem
CO3	**PO5**	**L2**	Using MATLAB, we can obtain a time domain specifications and response for a standard input
CO3	**PO12**	**L2**	Recognize the need of finding the time response and time domain specifications to the advanced electrical system problems in any areas.
CO4	**PO1**	**L2**	To determine the stability of a system using RH method by applying basic engineering knowledge
CO4	**PO2**	**L2**	To determine the stability of a time system using root locus method by applying engineering knowledge.
CO4	**PO3**	**L3**	Design of compensators using root locus techniques to meet the required stability conditions.

CO4	**PO5**	**L2**	Using MATLAB, plot the root locus of a given system to find its stability
CO4	**PO12**	**L2**	Recognize the need of time domain analysis to determine the stability of a given real time system under equilibrium conditions.
CO5	**PO1**	**L2**	To obtain frequency domain specifications of given system by applying the knowledge of engineering mathematics
CO5	**PO2**	**L2**	to determine the stability of a frequency domain system using bode plot method by applying engineering knowledge
CO5	**PO3**	**L3**	Design of compensators using bode plot techniques to meet the required stability conditions.
CO5	**PO5**	**L2**	Using MATLAB, plot the bode plot of a given system to find its stability
CO5	**PO12**	**L2**	Recognize the need of frequency analysis to determine the stability of a given real time system under equilibrium conditions.

SYLLABUS

UNIT – I **[14 Periods]**

TRANSFER FUNCTIONS OF LINEAR SYSTEMS

Impulse response of linear systems-block diagrams of control systems-signal flow graphs-reduction techniques for complex block diagrams and signal flow graphs.

UNIT – II **[8 Periods]**

INTRODUCTION TO MATHEMATICAL MODELLING OF PHYSICAL SYSTEMS

Equations of electrical networks modelling of mechanical systems- equations of mechanical systems.

UNIT – III **[12 Periods]**

TIME DOMAIN ANALYSIS OF CONTROL SYSTEMS

Time response of first and second order systems with standard input signals-steady state performance of feedback control systems-steady state error constants-effect of derivative and integral control on transient and steady state performance of feedback control systems.

UNIT – IV **[12 Periods]**

STABILITY ANALYSIS IN TIME DOMAIN

Concept of stability and necessary conditions for stability-Routh-Hurwitz criterion, relative stability analysis, the concept and construction of root loci, analysis of control systems with root locus.

UNIT – V **[14 Periods]**

STABILITY ANALYSIS IN FREQUENCY DOMAIN

Correlation between time and frequency responses - polar plots, bode plots-log magnitude versus phase plots-all pass and minimum phase systems-Nyquist stability criterion-assessment of relative stability-constant M&N circles.

TEXT BOOKS:

1. I.J. Nagrath& M.Gopal, “Control Systems Engineering”, Wiley Eastern Limited.
2. Benjamin C. Kuo, “Automatic Control Systems”, Prentice Hall of India.

REFERENCE BOOKS:

1. Ogata, “Modern Control Engineering”, Prentice Hall Of India

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Analog Electronic Circuits	
23EC4104	**Credits:3**
Instruction: 3 Periods & 1 E/week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Pre -requisites: Electronic Devices and Circuits

Course Objectives:

1. To analyze and design circuits using MOSFETs
2. To understand the concept of feedback and its characteristics as well as different feedback circuit configurations and its advantages
3. To understand the principles of oscillation and design various oscillator circuits and power amplifier circuits
4. To understand various power amplifier circuits.
5. To understand the MOS current sources, current mirrors, and differential amplifiers, focusing on design, performance enhancement, and small-signal operation.

Unit 1: **MOSFETs** **[12 Periods]**

Current-Voltage Characteristics of MOSFET, DC analysis, MOSFET as an amplifier and switch, biasing in MOS amplifier circuits, small signal operation and models, Single stage MOSFET amplifiers – CS, CG and CD amplifiers, frequency response of CS amplifier.

Unit 2: **Feedback Amplifiers** **[10 Periods]**

The general feedback structure, properties of negative feedback, Basic feedback topologies, Analysis of Series-shunt, series-series, shunt-shunt and shunt-series feedback amplifiers.

Unit 3: **Oscillators** **[10 Periods]**

Basic principles of sinusoidal oscillators and Barkhausen criterion, RC oscillators (phase shift and Wien bridge), LC oscillators (Hartley and Colpitts), Crystal Oscillator.

Unit 4: **Power Amplifiers:** **[08 Periods]**

Classification of amplifiers; Class A, Class B, Class AB, Class C – Circuit operation, transfer characteristics, power dissipation, efficiency.

Unit 5: Differential Amplifiers And Current Mirror Circuits: **[12 Periods]**

MOS Current Sources, Current Mirrors Circuits, Current Mirrors with improved performance. Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair.

Text Books:

1. Adel S Sedra, Kenneth C Smith and Arun N Chandorkar, "Microelectronic Circuits – Theory and Applications", Seventh Edition, Oxford University Press, 2017.
2. Millman's Electronic Devices and Circuits, J. Millman, C.C. Halkias, S. Jit, 4Edn, Mc Graw Hill, 2015**.**

References:

1. Donald A. Neamon, "Electronic Circuit Analysis and Design", 2nd Edition. TMG publications.
2. K Venkata Rao, K Rama Sudha, " Electronic Devices and Circuits",Mc Graw hill

Course Outcomes:

1. Analyze input resistance, output resistance, voltage gain and current gain of single stage amplifier circuits and its frequency response characteristics (L4)
2. Derive and analyze the expressions for voltage gain and input resistance of voltage series, voltage shunt, current series and current shunt negative feedback amplifiers.(L4)
3. Design and analyze RC and LC oscillators circuits (L5)
4. Derive the equation for power output and conversion efficiency of Class A, Class B and Class C of large signal power amplifier circuits(L4)
5. Analyze the DC characteristics of MOS current mirror circuits and small signal operation of MOS differential pair. (L4)

CO-PO-PSO mapping and Justification

		PO												PSO			Justification
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	
CO	**1**	3	2	-	-	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3
	2	3	2	-	-	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3
	3	3	3	3	-	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3,PI3.4.1
	4	3	3	3	-	-	-	-	-	-	-	-	-			2	PI1.4.1,PI2.1.3,PI3.4.1
	5	3	2	-	-	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3

PO1 Engineering Knowledge:
Performance Indicator, PI 1.4.1: Apply Electronics and Communication engineering concepts to solve engineering problems

PO2 Problem Analysis:
Performance Indicator, PI 2.1.3: Identify the mathematical, engineering, and other relevant knowledge that applies to a given problem

PO3 Design/Development of Solutions:
Performance Indicator, PI 3.4.1: Refine a conceptual design into a detailed design within the existing constraints (of the resources)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SIGNALS AND SYSTEMS LAB	
Code: 23EC4201	**Credits:1.5**
Instruction: 3 Periods & 1 O/Week	Sessional Marks:50
End Exam: 3 Hours	End Exam Marks:50

Pre -requisites: Signals & Systems

Course Outcomes:

By the end of the course student will be able to

CO	BL	CO Statement
CO1	BL-1, 2	Differentiate various signal functions & systems.
CO2	BL-4	Analyze LTI system characteristics in time domain.
CO3	BL-4	Analyze continuous-time signal characteristics in time and frequency domains.
CO4	BL-2	Demonstrate the requirement of sampling and correlation concepts.
CO5	BL-4	Analyze discrete-time signal characteristics in time and frequency domains.

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO	PO												PSO			Justification
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
1	2	1	-		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1
2	2	1	1		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 3.1.1, PI 5.1.1, PI 12.1
3	2	1	1		1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 3.1.1, PI 5.1.1, PI 12.1
4	2	1			1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1
5	2	1			1							1	2	1	1	PI 1.1.1, PI 1.4.1, PI 2.1.1, PI 5.1.1, PI 12.1.1

List of Experiments

Simulate following experiments using MATLAB/Simulink

Module-1: Introduction to MATLAB Basic Operations on Matrices

(a). To define & use variables, vectors, Matrices & its operation in MATLAB.
(b). To study various arithmetic operators and mathematical functions in MATLAB.
(c). To create & use m-files.

Module-2: Signals: operations & analysis

(a). Generation of Various Signals and Sequences
(b). Operations on Signals and Sequences (Addition, Multiplication, Scaling, Shifting, Folding, Energy and Power signals)
(c). Even and Odd Symmetry of Signals
(d). Fourier series of a Square Wave
(e). Fourier transform of a given signal and plotting its magnitude and Phase spectrum
(f). Find and verify the Laplace transform of a given signal using MATLAB. Plot the signals and the poles and zeros of their Laplace Transform.
(g). Z-Transform & Inverse Z-Transform of a discrete signal.
(h). Sampling theorem verification

Module-3: Systems: operations & analysis

(a). Basic system design using Simulink
(b). Convolution operation
(c). Autocorrelation and Cross-correlation
(d). Computation of unit samples, unit step and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties
(e). verification of linearity and time invariance properties of a given continuous / discrete system

Analog Electronic Circuits Lab	
23EC4201	**Credits:1.5**
Instruction: 3 Practical's & 1 O/week	Sessional Marks:50
End Exam: 3 Hours	End Exam Marks:50

Pre -requisites: Electronic Devices and Circuits

Course Objectives:

1. To analyze and design circuits using MOSFETs
2. To describe operation of single-stage Amplifiers and analyze its frequency response.
3. To understand the concept of feedback and its characteristics as well as different feedback circuit configurations and its advantages
4. To understand the principles of oscillation and design various oscillator circuits and power amplifier circuits

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Examine the frequency response of Single stage amplifiers using MOSFETs(L3)
2.	Obtain the DC characteristics of Differential MOS pair .(L3)
3.	Demonstrate the feedback amplifier circuits.(L3)
4.	Design sinusoidal oscillators for given frequency(L4)
5.	Determine efficiency of given power amplifiers(L3)

LIST OF EXPERIMENTS

Cycle-I (Multisim)

1. Obtain the frequency response and calculate Band width, Input & Output impedances of CS Amplifier
2. Obtain DC transfer characteristics of MOS differential pair
3. Obtain the frequency response of a voltage shunt feedback amplifier.
4. Generate a sinusoidal signal using Colpitts oscillator at a desired frequency.
5. Generate a sinusoidal signal using Wein bridge circuit.
6. Obtain the output waveforms of a class-A power amplifier and calculate the efficiency.

Cycle-II (Hardware)

1. Obtain the frequency response and calculate Band width of CS Amplifier.
2. Obtain the input and output impedance of a trans-conductance amplifier.
3. Generate a sinusoidal signal using RC phase shift oscillator and observe the lissajous patterns at different phase shifts.
4. Generate a sinusoidal signal using Crystal oscillator at a desired frequency.
5. Obtain the output waveforms of a class-B push-pull power amplifier and calculate the efficiency.

Note : Any ten experiments need to be completed by student.

CO-PO-PSO mapping and Justification

PO1 Engineering Knowledge:
Performance Indicator, PI 1.4.1: Apply Electronics and Communication engineering concepts to solve engineering problems

PO2 Problem Analysis:
Performance Indicator, PI 2.1.3: Identify the mathematical, engineering, and other relevant knowledge that applies to a given problem

		PO												PSO			Justification
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	
CO	**1**	3	2	-	3	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3,PI4.3.1
	2	3	2	-	3	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3,PI4.3.1
	3	3	2	3	3	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3,PI3.4.1 ,PI4.3.1
	4	3	2	3	3	-	-	-	-	-	-	-	-			2	PI1.4.1,PI2.1.3,PI3.4.1 ,PI4.3.1
	5	3	2	-	3	-	-	-	-	-	-	-	-			1	PI1.4.1,PI2.1.3,PI4.3.1

PO3 Design/Development of Solutions:
Performance Indicator, PI 3.4.1: Refine a conceptual design into a detailed design within the existing constraints (of the resources)

PO4Conduct Investigations of complex problems:
Performance Indicator, PI 4.3.1: Use appropriate procedures, tools and techniques to conduct experiments and collect data

Java Programming

(ECE)

CourseCode: ECE **Credits:1.5**

Instruction**:**1Lecture, 2 Practical/Week Sessional Marks :100

End Exam:3 Hours End Exam Marks :-

Prerequisites:

- Basic Knowledge of Programming Fundamentals

Course Objectives:

The course should enable the students:

1. To Understand Object Oriented Programming Concepts and Apply Them inProblemSolving.
2. To LearnTheBasicsofJavaConsoleandGUIBasedProgramming.

Course Outcomes:

1. DesignclassesforReal TimeApplications
2. Establishthe connectivityamongtheclassesusing Inheritancesand Interfaces..
3. ModularizeTheApplication UsingPackages andapplythreads on classes to achieveparallelismthroughsynchronization.
4. DevelopTestCasesByincludingtheruntimeerrorsusingExceptionshandling mechanismandMultiThreading.
5. IdentifyAWT components toDesign the GUIUsingApplet&AWTFramework

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1	1	2	3	1	1	-	-	-	-	-	1	1	2	-
	2	2	3	3	2	1	-	-	-	-	-	1	1	2	-
	3	1	3	3	1	1	-	-	-	-	-	1	1	2	-
	4	1	2	3	2	1	-	-	-	-	-	1	1	2	-
	5	2	1	3	2	1	-	-	-	-	-	1	1	2	-

Correlation levels1: Slight (Low) 2: Moderate (Medium) 3: Substantial(High)

SYLLABUS

Unit-I: **10Periods**

Fundamentals of Object Oriented Programming: Introduction, object oriented paradigm , Applications of OOP.

Java programming - History of Java, Java Buzzwords, Data types, variables, operators.Control structures, arrays, console input and output, Strings.

CodingExercises01:

1. Write a java program to find the Fibonacci series using recursive and non recursive functions
2. Write a java program to multiply two given matrices
3. Write a java program that reads a line of integers and displays each integers and the sum of all integers use String Tokenizer

Unit-II: **10Periods**

Classes and Objects: Introductionto Classes, objects, methods, constructors, parameter passing, overloading constructors andmethods, static, this, final,garbage collection.

Inheritance – Types, super keyword, Member access rules, Interface. .

CodingExercises02:

1. Develop a java Program to create classes and implement method and constructor overloading
2. Develop a java Program to implement the interface.
3. Develop a java Program to implement different types of inheritances.

Unit-III: **10Periods**

Polymorphism-Dynamicbinding, Methodoverriding, abstractclass, Interfaces, Defining and Implementing Interfaces.

Exception handling – Fundamentals, Exception types, use of try and catch, throw, throws,finally,multiple catches.

CodingExercises03:

1. Write a Java program to create an abstract class named Shape that contains two integers and an empty method named print Area (). Provide three classes named Rectangle, Triangle, and Circle such that each one of the classes Date using ParseException by using try catch and throws keywords.
2. Create an interface and implement the methods in two classes.
3. Write a Java Program to create a user defined exception.

Unit-IV: **10Periods**

Packages -Defining,CreatingandAccessingaPackage,importingpackages**Multithreading –** Introduction ,Thread Life cycle,Thread Priorities, Thread synchronization, Creatingmultiple threads.

CodingExercises04:

1. Create a user defined package and import it and implement the methods.
2. Write a Java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number
3. Create two packages and import the classes and implement the two methods.

Unit-V: **10Periods**

AbstractWindow Toolkit

AWT& Swings:API of awt and Swings,Border Layout, Flow Layout,Grid Layout.

CodingExercises05:

1. Write a java program that works as a simple calculator. Arrange Buttons for digits and for the + - * % operations. Add a text field to display the result.

TEXT BOOKS

1. HerbertSchildt,"JAVATheCompleteReference",TataMcGrawHill,seventhedition.
2. EBalagurusamy,"ProgrammingwithJAVA -A Primer"–ThirdEdition.

REFERENCE BOOKS

1. P.J. Deitel and H.M. Deitel, "Java for Programmers", Pearson education (OR) P.J.DeitelandH.M. Deitel,"Java: HowtoProgram", PHI.
2. P.RadhaKrishna,"ObjectOrientdProgrammingthroughJava",UniversitiesPress.

Logical Reasoning & Corporate Skills
(II Year, I Sem.)

Course Category:	Humanities	**Credits:**	1
Branch	All Branches		
Course Code:	23TP9101	**Lecture-Tutorial-Practical:**	2+2
Prerequisites:	Knowledge of LSRW Skills, Basic Maths	**Continuous Evaluation:**	
		Semester End Evaluation:	
		Total Marks:	100

	Upon successful completion of the course, the student will be able to:	
Course Outcomes	**CO1**	Enforce corporate etiquette, and precise usage of English grammar to enhance their professional communication. L3
	CO2	Master negotiation skills and telephone etiquette with emotional intelligence for corporate interactions. L3
	CO3	Enhance email writing skills by incorporating vocabulary acquired from storytelling, situational dialogues and reading activities by using various digital tools. L3
	CO4	Use their logical thinking and analytical abilities to solve reasoning questions from number analogy and series and letter based aptitude questions company specific and other competitive tests.
	CO5	Solve questions related to clock and calendar , etc.. from company specific and other competitive tests.

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									M	M		M		
CO2									M	M		M		
CO3									M	M		M		
CO4	M													
CO5	M													

L- Low **M-Medium** **H-High**

PART-A: Corporate Skills

Unit-I Corporate Etiquette – Work Place Etiquette and Conflict Resolution - Grammar Revision Verbal Ability : Prepositions, Articles, tenses and conjunction	CO1
Unit-II EQ – Negotiation Skills – Telephone Etiquette – MNCs Paper Model Introduction, Situational Dialogue Practice – Team Activities Related to Spoken English Verbal Ability: Fill in the blanks (Based on the given appropriate words)	CO2
Unit-III E Mail Writing – Vocabulary from Story Telling Activity –MNCs Model Paper 1 Practice Verbal Ability: Sentence arrangements	CO3
Unit-IV Virtual Reading – Functional English – IELTS Vocabulary – News Paper Reading Using AI Based Applications Verbal Ability: Inferred meaning (Homophones, Homonyms)	CO3

PART-B: Logical Reasoning	
UNIT-I: Numerical computation: Number Series, Letter Series, Number analogy, letter analogy, word analogy	CO4
UNIT-II: Coding Decoding- Letter to letter, letter to digit, letter to number and symbol, Word to word coding, odd man out	CO4
UNIT-III: Directions-Finding distance, Direction and Shadow based problem, Blood Relations-Mixed Blood Relations, Puzzle-Based Blood Relation, Single-Person Blood Relation, Symbol based Blood Relations.	CO4
UNIT-IV: Clocks –finding Angle, Time, Mirror image, Faulty clock, Calendars – Finding day of the week, Number of odd days, Repetition of same calendar	CO5
UNIT-V : Seating Arrangement-Circular arrangement, linear arrangement ,Order Sequence and Ranking	CO5

Entrepreneurship Development & IPR							
Code	Periods			Sessional Marks	End Exam Marks	Total Marks	Credits
	L	T	P				
23MC0104	30			100	-	100	-

Prerequisite: xxx

Course Objectives: The course has been designed to develop the skills of entrepreneurship & to encourage the students to become an entrepreneur and to impart the basics of Intellectual property Rights.

Course Outcomes: At the end of the course the student will be able to:	
CO-1	Apply various theories for the entrepreneurship development ecosystem in Indian context.
CO-2	Demonstrate the ways in which entrepreneurs perceive opportunity, manage risk, organize resources and add value.
CO-3	Identify various schemes supporting entrepreneurship.
CO-4	Recognize the importance of IP and outline concepts of Intellectual Property Rights.
CO-5	Identify the significance of practice and procedure of Patents.

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

Course Outcomes	PSO1	PSO2
CO-1		1
CO-2		1
CO-3		1
CO-4		1
CO-5		1

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS	
UNIT - I	**Periods: 4L+2T=6**
UNIT TITLE: Introduction to Entrepreneurship	
Entrepreneurship- Concept, Nature, Functions and Importance; Entrepreneurs Characteristics, Types and Motivation; Entrepreneurial process; Enterprise- Definition and Classification (MSME Micro, Small & Medium Enterprises).	
UNIT - II	**Periods: 4L+2T=6**
UNIT TITLE: Entrepreneurial Journey	
Creativity and Innovation, Recognizing opportunities and Generating ideas, Feasibility analysis, Industry and Competitor analysis, developing effective business model. **Class Activity:** Idea generation by students.	
UNIT - III	**Periods: 4L+2T=6**
UNIT TITLE: Institutional Support to Entrepreneurs	
Need for Institutional support different Government & Non-Government institutions to support Entrepreneurs like, NSIC, SIDO, SSIB, SSIDC, SISIs , DTICs, industrial Estates, Specialized Institutions.	
UNIT - IV	**Periods: 4L+2T=6**
UNIT TITLE: INTRODUCTION TO IPR	
Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights – Introduction to TRIPS and WTO. – Kinds of Intellectual property rights—Copy Right, Patent, Trade Mark, Trade Secret and trade dress, Design, Layout Design, Geographical Indication, Plant Varieties and Traditional Knowledge.	
UNIT - V	**Periods: 4L+2T=6**
UNIT TITLE: Patent system in India	
Patents Act 1970 & Patent system in India; Patentability; Process, & product patent; filing of the patent, patent specification, patent claims, Patent opposition, & revocation, infringement, compulsory licensing, Patent Cooperation Treaty, Patent search, and patent database.	
TEXT BOOKS:	
1.	Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 9th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2014.
2.	Bruce R. Barringer and R. Duane Ireland, "Entrepreneurship", 4th Edition, Pearson Publications, New Delhi, 2011
3.	N.K. Acharya, Text book on intellectual Property Rights, Asha Law House New Delhi, New Edition, 2001.
REFERENCE BOOKS:	
1.	Narayanan, V. K., Managing technology and innovation for competitive advantage, first edition, Pearson education, New Delhi, (2006)
2.	Idris, K. (2003), Intellectual property: a power tool for economic growth, second edition, WIPO publication no. 888, Switzerland

3.	Bosworth D. & Webster E , The Management of Intellectual Property, Edward Elgar.
WEB RESOURCES:	
1.	https://ebooks.inflibnet.ac.in/hsp15/chapter/intellectual-property-management/
2.	https://onlinecourses.nptel.ac.in/noc20_hs66/preview

R23 2nd Year Course Structure
Electronics and Communication Engineering

Semester - II										
Course Code	Title of the course	Category	Periods				Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	Total				
23MA1108	Complex Variables and Partial Differential Equations	BS	3	-	-	3	40	60	100	3
23EC4107	Linear & Digital IC Applications	PC	3	-	-	3	40	60	100	3
23EC4108	Analog & Digital Communications	PC	3	-	-	3	40	60	100	3
23EC4109	Electromagnetic Waves & Transmission Lines	PC	2	1	-	3	40	60	100	3
23ME3203	Design Thinking	ES	2	-	-	2	40	60	100	2
23EC3105	Python Programming for Engineers	ES	2	-	2	4	40	60	100	3
23EC4205	Analog & Digital Communication Lab	PC	-	-	3	3	50	50	100	1.5
23EC4206	Linear & Digital IC Applications Lab	PC	-	-	3		50	50	100	1.5
23EC9202	Skill Oriented Course* (Design through Verilog)	SC	-	-	3		50	50	100	1.5
23CR9102	Numerical Ability and Professional Communication	HS	-	-	2		50	0	50	1
23MC0103	Financial Literacy	MC	2	-	-	2	50	0	50	-
Total			17	1	13	23	490	510	1000	22.5

COMPLEX VARIABLES & PARTIAL DIFFERENTIAL EQUAITONS
(Common to ECE and EEE)

23MA1108 **Credits:3**

Instruction : 3 periods & 1 Tutorial/Week Sessional Marks:40
End Exam : 3 Hours End Exam Marks:60

Prerequisites: Complex numbers, Differentiation, Integration and functions.

Course Objectives:

The aim of this course is to study the techniques of complex variables and functions together with their derivatives, contour integration and provide the foundations of curve fitting, correlation and regression analysis.

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

1	Analyze limit, continuity and differentiation of functions of complex variables and understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
2	Use of Cauchy's theorem, Cauchy's integral and Cauchy's residue theorems and apply these in evaluation of complex contour integrals and able to represent the given functions as Taylor's and Laurent's series, and determine their intervals of convergence. Also, understand the concepts of singularities, residues and evaluation of improper integrals by using residues.
3	Construct partial differential equation of a given equation and solve first order partial differential equations and their applications.
4	Familiar with numerical solution of ordinary differential equations.
5	Evaluate simple correlation between the two variables and fit curves by the method of least square approximation.

CO-PO –PSO Mapping:

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

Correlation levels 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping of Course Outcomes with Program Outcomes &Program Specific Outcomes:

CO-PO-PSO Justification	
1	CO1 deals with properties of analytic functions and finding analytic functions, these are widely used in many areas of engineering.
2	CO2 deals with finding the values of complex contour integration and series representation of a given complex function by using Taylor's and Laurent's series, and these are used in various fields of engineering.
3	CO3 deals with formation, finding solution and applications of PDE and there are widely used in various fields of engineering.
4	CO4 deals with finding the numerical solution of a given IVP problems.
5	CO 5 deals with the knowledge of curve fitting is widely used as an aid for data visualization and regression is to summarize the relationship among two or more variables.

SYLLABUS

UNIT I **10 Periods**

FUNCTIONS OF A COMPLEX VARIABLE

Complex function – Real and Imaginary parts of complex function – Limit – Continuity and derivative of a complex function – Cauchy-Riemann equations – Analytic function, entire function, singular point, conjugate function – Cauchy-Riemann equations in polar form – Harmonic functions – Milne-Thomson method – Simple applications to flow problems – Applications to flow problems.

UNIT II **10 Periods**

COMPLEX INTEGRATION, SERIES OF COMPLEX TERMS AND RESIDUES

Complex integration – Cauchy's theorem – Cauchy's integral formula – Series of complex terms: Taylor's series – Maclaurin's series expansion – Laurent's series – Singularities – Residues – Calculation of residues – Cauchy's residue theorem. (All theorems without proofs)

Evaluation of real definite integrals: Integration around the unit circle – Integration around a semicircle.

UNIT III **10 Periods**

PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS

Introduction – Formation of partial differential equations by eliminating arbitrary constants and functions – Solutions of a partial differential equations by direct Integration – Linear equations the first order (Lagrange's linear equations).

APPLICATIONS : Method of separation of variables – Vibrations of a stretched string: Wave equation – One dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and two dimensional heat flow equation. (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

UNIT IV **10 Periods**

NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS

Picard's method – Taylor's series method – Euler's method, Runge - Kutta method, Predictor - Corrector methods : Milne's method,

UNIT V **10 Periods**

CORRELATION, REGRESSION ANALYSIS AND CURVE FITTING

Correlation : Definition – Karl pearson's coefficient of correlation – Measures of correlation – Rank correlation coefficients.

Regression : Simple linear regression – Regression lines and properties.

Curve Fitting : Principle of least squares – Method of least squares – Fitting of straight lines – Fitting of second degree curves and exponential curves.

TEXT BOOKS:

B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

2. N. P. Bali, Engineering Mathematics, Lakshmi Publications.

3. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas, Calculus, 13/e, Pearson Publishers, 2013.

4. H. K. Dass, Advanced Engineering Mathematics, S. Chand and complany Pvt. Ltd.

5. Michael Greenberg, Advanced Engineering Mathematics, Pearson, Second Edition.

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Linear & Digital IC Applications	
Code: 23EC4105	**Credits:3**
Instruction:3periods&1e/week	Sessionalmarks:40
Endexam:3hours	End exammarks:60

Pre-requisites: Switching Theory & Logic Design, Analog Electronic circuits

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

CO	BL	CO Statement
CO1	BL-4	Familiarization of op-amp characteristics and Design linear and nonlinear applications of Op-amp
CO2	BL-4	Synthesize waveforms using Op-amp and Analyze the applications of voltage regulators, Timer IC 555 and PLL
CO3	BL-4	Design ADC and DAC using Op-amps and Active Filters for the desired cut off frequency
CO4	BL-3	Choose the proper Combinational digital integrated circuits by knowing their characteristics
CO5	BL-3	Choose the proper Sequential digital integrated circuits by knowing their characteristics

CO	Bloom's Level
CO1	Action Verb from Blooms Taxonomy-**Design**/Cognitive level- Analysis (BL-4)
CO2	Action Verb from Blooms Taxonomy-**Design**/Cognitive level- Application (BL-4)
CO3	Action Verb from Blooms Taxonomy- **Design** /Cognitive level- Analysis (BL-4)
CO4	Action Verb from Blooms Taxonomy-**Apply**/ Cognitive level- Application (BL-3)
CO5	Action Verb from Blooms Taxonomy-**Apply**/ Cognitive level- Application (BL-3)

Program Matrix

COs	Program Outcomes (POs)												PSOs			Justification
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
CO1	2	3	2	-	-	-	-	-	-	-	-	1	-	-	1	P1.2.1, P1.3.1, P2.1.2, P2.1.3, P3.2.1,P12.1.1,
CO2	2	3	2	-	-	-	-	-	-	-	-	1	-	-	1	P1.3.1, P1.4.1, P2.1.2, P2.1.3, P2.2.3, P3.2.1, P3.2.3, P12.1.1
CO3	2	2	3		-	-	-	-	-	-	-	1	-	-	1	P1.2.1, P1.3.1, P2.4.1, P3.2.1, P3.2.3,P12.1.1
CO4	2	2	2		-	-	-	-	-	-	-	1	-	-	1	P1.3.1, P1.4.1,P2.1.2, P2.1.3, P2.2.3, P3.2.1, P3.2.3, P12.1.1
CO5	2	2	2	-	-	-	-	-	-	-	-	1	-	-	1	P1.3.1, P1.4.1, P2.1.2, P2.1.3, P2.2.3, P3.2.1, P3.2.3,P12.1.1

Justification of CO mapping with POs and PSOs

Course outcome	PO Mapped	Level Mapped	Justification for Mapping
CO1	PO1	2	Student will be able to apply the knowledge of basic engineering sciences, core engineering in designing various operational amplifiers
	PO2	3	Able to identify, analyse the problems in operational amplifier applications
	PO3	2	Able to apply the knowledge of characteristics of OP-Amp in developing linear ICs related projects
	PO12	1	Able to apply the knowledge of Linear ICs concepts in developing the new technologies s and their outcomes in multidisciplinary areas.
	PSO3	1	Apply the knowledge of engineering fundamentals to formulate, analyse and provide appropriate problem solving strategies in the field of embedded and VLSI and communicate them effectively to the concern.
CO2	PO1	2	Student will be able to apply the knowledge of timer ICs and different linear ICs concepts in modelling and designing analog based systems
	PO2	3	Able to identify, analyze the problems in different domains
	PO3	2	Able to apply the knowledge of engineering to develop and assess projects and their outcomes in multidisciplinary areas.
	PO12	1	Able to apply the knowledge of new linear ICs in developing the new technologies s and their outcomes in multidisciplinary areas.
	PSO3	1	Apply the knowledge of engineering fundamentals to formulate, analyse and provide appropriate problem solving strategies in the field of embedded and VLSI and communicate them effectively to the concern.
CO3	PO1	2	Student will be able to apply the knowledge of engineering sciences, core engineering concepts in designing Analog based Systems.
	PO2	2	Able to identify, analyze the complex problems in different domains.
	PO3	3	Able to apply the knowledge of data converters in designing digital systems and assess projects in multidisciplinary areas.
	PO12	1	Able to apply the knowledge of digital analog concepts in multidisciplinary areas.
	PSO3	1	Apply the knowledge of engineering fundamentals to formulate, analyse and provide appropriate problem solving strategies in the field of embedded and VLSI and communicate them effectively to the concern.
CO4	PO1	2	Student will be able to apply the knowledge of engineering sciences, core engineering and computing concept in designing computer based systems.
	PO2	2	Able to identify, analyze the problems in different domains
	PO3	2	Able to apply the knowledge of combinational circuits in designing digital systems and projects and their outcomes in multidisciplinary areas.
	PO12	1	Able to apply the knowledge of digital concepts in developing the new technologies s and their outcomes in multidisciplinary areas.
	PSO3	1	Apply the knowledge of engineering fundamentals to formulate, analyse and provide appropriate problem solving strategies in the field of embedded and VLSI and communicate them effectively to the concern.
CO5	PO1	2	Student will be able to apply the knowledge of engineering sciences, core engineering and computing concept in designing computer based systems.
	PO2	2	Able to identify, analyse the problems in different domains
	PO3	2	Able to apply the knowledge of counters and Sequential circuits in designing digital systems and assess projects and their outcomes in multidisciplinary areas.
	PO12	1	Able to apply the knowledge of digital concepts in developing the new technologies s and their outcomes in multidisciplinary areas.
	PSO3	1	Apply the knowledge of engineering fundamentals to formulate, analyse and provide appropriate problem solving strategies in the field of embedded and VLSI and communicate them effectively to the concern.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

SYLLABUS

UNIT –I OPERATIONAL AMPLIFIERS AND APPLICATIONS [9 Periods]

Differential Amplifier using BJT, Modes of Operation: Common Mode, Differential Mode, Block Diagram of Op-Amp, Ideal and Practical characteristics of Op-Amp, Modes of Operation-Inverting, Non-Inverting, Differential, Applications of Op-Amp- Adder and Subtractor, Instrumentation Amplifier, Differentiators and Integrators, Comparators, Schmitt Trigger, Log Amplifier.

UNIT– II

[9 Periods]

WAVEFORM GENERATORS, IC555, IC565, VOLATGE REGULATOR APPLICATIONS

Waveform Generators – Square Wave, Triangular and Quadrature oscillator, IC555 Timer-Functional Diagram, Monostable and Astable Operations, Applications, IC565 PLL-Block Schematic, principle and Applications. Introduction to Voltage Regulators- Three Terminal Voltage Regulators, Features of 723 Regulator, Switching Regulator

UNIT– III

ADC AND DAC, ACTIVE FILTERS [9 Periods]

Basic DAC techniques, Different types of DACs-Weighted resistor DAC, R-2R ladder DAC, Inverted R-2R DAC, Different Types of ADCs – Parallel Comparator Type ADC, Counter Type ADC, Successive Approximation ADC and Dual Slope ADC, DAC and ADC Specifications.
Introduction to Active Filters, Analysis of 1st order LPF & HPF Butterworth Filters, Characteristics of Bandpass, Band reject and All Pass Filters

UNIT– IV COMBINATIONAL LOGIC ICs [9 Periods]

Combinational Logic ICs: Specifications and Applications of TTL-74XX & CMOS 40XX Series ICs – Code Converters, Decoders, LED & LCD Decoders with Drivers, Encoders, Priority Encoders, Multiplexers, Demultiplexers, Priority Generators/Checkers, Parallel Binary Adder/Subtractor, Magnitude Comparators.

UNIT– V SEQUENTIAL LOGIC ICs AND MEMORIES [9 Periods]

Sequential Logic IC's and Memories: Familiarity with commonly available 74XX & CMOS40XX Series ICs -All Types of Flip-flops, Synchronous Counters, Decade Counters, Shift Registers.
Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

TEXTBOOKS:

1. Ramakanth A. Gayakwad - Op-Amps & Linear Integrated Circuits, Pearson Education, 4th Edition, 2015.
2. Floydand Jain- Digital Fundamentals, 11th Edition, Pearson Education,2017.

REFERENCEBOOKS:

1. D. Roy Chowdhury – Linear Integrated Circuits, New Age International Pvt. Ltd, 6th Edition, 2021.
2. John. F. Wakerly – Digital Design Principles and Practices, 3rd Ed., Pearson, ,2009.
3. S Salivahanan, V S Kanchana Bhaskaram -Linear Integrated Circuits, McGraw Hill Education, 2018.
4. Jan m Rabey- Digital Integrated circuits, 2nd Ed., Pearson Education India, 2016.

ANALOG & DIGITAL COMMUNICATIONS	
CODE: 23EC4108	**Credits: 3**
Instruction: 4 Periods & 1 Tut/week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Prerequisite: Signals and Systems, Probability theory and Random Process

Course Outcomes: Upon completing this course, the student will be able to

CO1: Illustrate different AM modulation and demodulation schemes with the functioning of AM transmitter and Receiver.

CO2: Analyze the generation and detection schemes of Angle Modulation types with the functioning of FM transmitter and Receiver.

CO3: Analyze and Differentiate Analog Pulse Modulation Techniques and Digital Base Band Modulation Techniques.

CO4: Compare and Analyze band pass digital modulation techniques like ASK, PSK and FSK.

CO5: Calculate the Probability of Error to analyse the performance of various Digital Modulation Techniques.

UNIT – I **[10 Hours]**

Amplitude Modulation: Need for modulation, Amplitude Modulation - Time and frequency domain description, , power relations in AM waves, Generation and detection of AM waves – Square Law modulator, Envelope detector. DSBSC modulation, Generation and detection of DSBSC Wave - Balanced Modulator, Coherent detector, COSTAS Loop, SSB modulation, Generation and detection of SSB Phase discrimination method, Coherent detector, Principle of Vestigial side band modulation. AM transmitter and Block diagram of Super Heterodyne receiver.

UNIT – II **[10 Hours]**

Angle Modulation: Basic concepts of Phase Modulation, Frequency Modulation: Single tone frequency modulation, Narrow band FM, Wide band FM, Constant Average Power, Transmission bandwidth of FM Wave , Generation of FM Signal- Armstrong Method, Detection of FM Signal: Balanced slope detector, Phase locked loop, Block diagram of FM transmitter and FM receiver.

UNIT – III **[10 Hours]**

Pulse Modulation: Types of Pulse modulation- PAM, PWM and PPM.

Base Band Modulation Techniques: PCM Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, DPCM, DM and Adaptive DM, Noise in PCM and DM.

UNIT – IV **[10 Hours]**

Band Pass Modulation Techniques:

Gram-Schmidt orthogonalization, Euclidean Distance, Coherent Detection of signals in noise using Maximum likelihood decoding, Generation and detection of BASK, BFSK, BPSK, QPSK, DPSK, QAM, M-Ary PSK, and M-Ary FSK.

UNIT – V **[10 Hours]**

Baseband Transmission and Optimal Reception of Digital Signal: Optimum Receiver and its Probability of Error, Matched Filter and its Probability of Error, Probability Error of ASK, FSK and PSK, Nyquist Zero ISI criterion.

TEXTBOOKS:

1. Analog and Digital Communications – Simon Haykin, John Wiley, 2012.
2. Electronics Communication Systems-Fundamentals through Advanced-Wayne Tomasi, 5th Edition, 2009, PHI.

REFERENCE BOOKS:

1. Analog Communications by P Rama Krishna Rao, McGraw Hill Education-2017
2. Principles of Communication Systems - Herbert Taub, Donald L Schilling, Goutam Saha, 3rd Edition, McGraw-Hill, 2008.
3. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004
4. Analog and Digital Communication – K. Sam Shanmugam, Willey ,2005

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Electromagnetic Waves and Transmission Lines	
23EC4109	**Credits:3**
Instruction: 3 Periods & 1 E/week	Sessional Marks:40
End Exam: 3 Hours	End Exam Marks:60

Pre -requisites: Linear Algebra, Vector Calculus

Course Outcomes:

By the end of the course, the student will be able to:
1. Apply vector calculus and laws of physics to solve the problems of electrostatic fields
2. Apply magnetostatic laws to solve the problems related to magnetostatic fields
3. Analyze time varying fields using Maxwell's equations in differential and integral forms
4. Analyze the phenomenon of Electromagnetic waves in conducting and dielectric medium.
5. Design stubs using smith charts based on the concepts of transmission lines

CO-PO-PSO mapping

		PO												PSO			Justification
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	
CO	**1**	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	2	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	3	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3,PI3.4.1
	4	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	5	3	3	2	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3,PI3.4.1

Unit 1: **Electrostatic Fields** **[10 Periods]**

Review of vector analysis, Coulomb's law and field intensity, Electric Fields due to continuous charge distributions, Electric flux density, Gauss's law and applications, Electrostatic maxwells equations, Electric potential, relationship between E and V, Energy density in electrostatic fields, convection and conduction currents, polarization in dielectrics, continuity equation and relaxation time, poissons and Laplace equations.

Unit 2: **Magnetostatic Fields** **[10 Periods]**

Biot-Savarts law, Amperes circuit law, Applications of amperes circuit law, Magnetic flux density, maxwells equations for static EM fields, magnetic scalar and vector potentials, Forces due to magnetic fields, magnetic torque and moment, magnetic dipole, magnetization in materials, Classification of magnetic materials, Magnetic energy.

Unit 3: Maxwells Equations **[8 Periods]**

Faraday's Law, Displacement current, inconsistency of amperes law, equation of continuity for time-varying fields, Maxwells equations, Boundary conditions in electric fields and magnetic fields

Unit 4: **Electromagnetic waves** **[10 Periods]**

Introduction, Applications of EM waves, solutions for free space condition, Uniform plane wave propagations, uniform plane waves, wave equations conducting medium, sinusoidal time variations, conductors & dielectrics, Depth of penetration, Direction cosines, Polarization of a

wave, reflection by a perfect conductor – Normal incidence, Oblique incidence, reflection by a perfect dielectric-Normal incidence, reflection by a perfect insulator – oblique, Total internal reflection, Brewster angle, Surface impedance, Poynting vector and flow of power, Complex Poynting vector.

Unit 5: **Transmission Lines** **[10 Periods]**

Transmission Line parameters, Transmission Line equations, primary and secondary constants, Input impedance VSWR, reflection coefficient, Power and Lines of different lengths (λ/8, λ/4,λ/2), Smith chart, applications of Transmission lines (Quarter wave transformer, single stub tuner, slotted line).

Text Books:

1. Matthew N.O. sadiku and S.V. Kulkarni - Principles of Electromagnetics, 6 th Ed., Oxford University Press, Aisan Edition, 2015. **(Unit-I, Unit-II, Unit-III)**
2. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, 2nd Edition, PHI, 2000. (**Unit-IV,Unit-V**)

References:

1. G.S.N.Raju, Electromagnetic Field Theory And Transmission Lines, Pearson Education (Singapore) Pvt., Ltd., New Delhi, 2005.
2. G. Sasi Bhushana Rao, "Electromagnetic Field Theory and Transmission Lines", Wiley, India Pvt. Ltd, 2012.

CO-PO-PSO mapping and Justification

		PO												PSO			Justification
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	
CO	**1**	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	2	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	3	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3,PI3.4.1
	4	3	2	1	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3
	5	3	3	2	-	-	-	-	-	-	-	-	-		2		PI1.4.1,PI2.1.3,PI3.4.1

PO1 Engineering Knowledge:
Performance Indicator, **PI 1.4.1**: Apply Electronics and Communication engineering concepts to solve engineering problems

PO2 Problem Analysis:
Performance Indicator, **PI 2.1.3**: Identify the mathematical, engineering, and other relevant knowledge that applies to a given problem

PO3 Design/Development of Solutions:
Performance Indicator, **PI 3.4.1**: Refine a conceptual design into a detailed design within the existing constraints (of the resources)

DESIGN THINKING

23ME3203 **Credits:2**

Instruction : 1 periods & 2 Practical/Week Sessional Marks:50

End Exam Marks:50

Prerequisite: Branch specific

Course Objectives:

1. To familiarize students with design thinking concepts and principles
2. To ensure students can practice the methods, processes and tools of design thinking.
3. To ensure students can apply the design thinking approach and have ability to model real world situations.
4. To enable students to analyze primary and secondary research in the introduction to design thinking

Course Outcomes: At the end of the course the student will be able to:	
CO-1	**Explain** the design thinking principles & **Identify** an opportunity and scope of the project and **prepare** the problem statement
CO-2	**Apply** the empathy tools to study the user and **summarize** finding related to problem for define phase.
CO-3	**Describe** and **define** the problem specific to the user group and **apply** Ideation tools to **generate** Ideas to **solve** the problem
CO-4	**Develop** prototypes for test phase.
CO-5	**Test** the ideas and **demonstrate** Storytelling ability to present the Ideas.

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

Course Outcomes	PSO1	PSO2
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS

Module 1: Introduction to Design Thinking: Need of design thinking, 7 characteristics of design thinking, comparison of design thinking to other ways of thinking, tools and resources, 5 actions phases of Design thinking, 5 characteristics of action plan. Summary of 5 Thinking mindsets. 5W+H & HMW Tools.

Module 2: Empathy: Think users first, inherent needs of the user, empathize the user, effectively interviewing the users, Ask 5x why, Stake holders Map, Persona, Empathy map,

Module 3: Define: Ask the right question, different types of questions, Design Brief, Opportunity map, POV Statement

Module 4: Ideate: Communicate by drawing, Value of Drawing, rules of ideation, 5 common ideation techniques, Brainstorming, Prioritisation Map, Dot voting, idea evaluation

Module 5: Prototype to Test phase: Types of rough Prototype, need of a Prototype, Need of Prototype testing, Structured Test-Experience lab. Prototype evaluation, observers debrief, Feedback Capture grid

Week	Activity	Marks
1.	Identify an opportunity and scope of the project for providing solution through design thinking.	1
2.	Prepare the initial Problem statement for the identified problem by 5W+H & HMW Tools.	2
3.	Identify the stake holders and prepare the questionnaire to perform Interview for Empathy among stake holders.	2
4.	Apply Ask 5x why tool for identifying the cause identification of the problem.	2
5.	Prepare the Persona based on the responses received from the Stake holders	2
6.	Prepare the Empathy Map/ Customer Journey Map for summarizing pains & gains of stakeholders and insights	2
7.	Prepare the Point of View statement based on user insights and Re-define the problem statement using HMW tool based on the of the customer	2
8.	Perform Brainstorming Session to generate Ideas.	2
9.	Cluster and shortlist the ideas to prepare the prototype	2
10.	Prepare the prototypes for the shortlisted ideas	4
11.	Test the prototype with user and record the responses in feedback capture Grid	2
12	Modify the prototype as per the user feedback.	2

TEXT BOOKS:

1. Daniel Ling "*Complete Design Thinking Guide for Successful Professionals*", Emerge Creatives Group LLP, Print ISBN: 978-981-09-5564-9.
2. Michael Lewrick, Patrick Link, Larry Leifer, *The Design Thinking Toolbox,* John Wiley & Sons, 2020.

REFERENCE BOOKS:	
1.	Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins e-books, 2009.
2.	Jeanne Liedtka, Andrew King, And Kevin Bennett, "Solving Problems with Design Thinking" , Columbia University Press Publishers, E-ISBN 978-0-231-53605-9
3.	Idris Mootee, *"Design Thinking for Strategic Innovation"* , 2013 John Wiley & Sons
4.	Michael G. Luchs, Scott Swan, Abbie Griffin , *"Design Thinking: New Product Development Essentials from the PDMA"*, ISBN-13 : 978-1118971802
5.	Beverly Rudkin Ingle, *"Design Thinking for Entrepreneurs and Small Businesses"*, Apress, ISBN: 9781430261827
6.	Jose Betancur *"The Art of Design Thinking: Make More of Your Design Thinking Workshops",* ISBN: 9781522095378
WEB RESOURCES:	
1.	https://dschool.stanford.edu/resources/design-thinking-bootleg
2.	https://www.ideo.com/post/design-thinking-for-educators
3.	https://onlinecourses.nptel.ac.in/noc22_mg32/preview
4.	https://onlinecourses.swayam2.ac.in/imb23_mg65/course

Proposed Design Thinking Lab Evaluation – 100M

Internal Evaluation: 50 M

Continues Assessment of Activities: 25 M

Internal Exam- Objective/ Written test: 20 M

Attendance: 5 M

External Evaluation: 50M

Prototype Validation: 20 M

Report: 10M

Presentation: 10M

Viva: 10M

PYTHON PROGRAMMING FOR ENGINEERS (ECE)	
Code: 23EC3105	**Credits : 3**
Instruction **:** 3 Periods & 1 Tut/Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:
Basic Knowledge of Programming Fundamentals

Course Objectives:
The course should enable the students:

COURSE OBJECTIVES:

- Describe the core syntax and semantics of Python programming language.
- Illustrate the process of structuring the data using lists, dictionaries, tuples, strings and sets.
- Discover the need for working with the functions, modules and packages.
- Infer the Object-oriented Programming concepts in Python.
- Familiarize the advanced concepts like Iterators, generators, decorators and Indicate the use of regular expressions and built-in functions to navigate the file system.

.**Course Outcomes:**

By the end of the course, the student will be able to:	
1.	Interpret the fundamental Python syntax and semantics and able to solve, test and debug python programs
2.	Fluency in the use of Python control flow statements and Determine the methods to create and manipulate Python programs by utilizing the data structures like lists,
3.	Express proficiency in the handling of functions, modules and packages.
4.	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python
5.	List the usage and application of iterators, generator, decorators and Identify the commonly used operations involving file systems and regular expressions.

Mapping of Course Outcomes with Program Outcomes:

S.No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1														
CO 2														
CO 3														
CO 4														
CO5														

SYLLABUS

UNIT-I:

10 periods

Introduction: Installation, Keywords and Identifiers, Statement, Indentation, Comments, Variables, Constants, Literals, Data Types, Type Conversion, I/O, Import, Operators (Arithmetic operators, Comparison operators, Logical operators, Bitwise operators, Assignment operators, Identity operators, Membership operators), Namespace and Scope.

Learning Outcome: At the end of this Unit the student will be able to

- Analyse fundamental advantages of python over the other programming languages.
- Solve, test and debug basic problems using python script.

UNIT-II:

14 periods

Flow control & Collections: If, If...else, if...elif...else, Nested if, for loop, while loop, Break, Continue and Pass. Numbers, Decimal, Fractions, Mathematics, List, Tuple, String, Set and Dictionary. Data types manipulations (create, Index, Negative indexing, Slicing, change or add elements, delete or remove elements, Methods, Comprehension, Membership Test, Iteration, Operations and Built in Functions)

Learning Outcome: At the end of this Unit the student will be able to

- Implement Flow control statements required real world problems.
- Manipulate python programs by using the python data structures like lists, dictionaries, tuples, strings and sets.

UNIT-III:

12 periods

Functions: Function, Function argument, Recursion, Anonymous / Lambda functions, Global, Local and Nonlocal variables, Global keyword, Modules and Packages.

Learning Outcome: At the end of this Unit the student will be able to

- Resolve real world problems using python functions.
- Familiarize the usage of Modules and packages to enhance the problem solving.

UNIT-IV:

12 periods

Object oriented programming: Introduction to OOPs, Class, Object, Constructors, Methods, Inheritance, Method Overriding, Multiple Inheritance, Operator overloading, Encapsulation and Polymorphism.

Learning Outcome: At the end of this Unit the student will be able to

- Design object-oriented programs with Python classes.
- Usage of inheritance, encapsulation, inheritance and polymorphism for reusability.

UNIT-V:

12 periods

Advanced topics: Iterators, Building Your Own Iterator, Infinite Iterators, Generators, Generator Expression, Closure Function, Decorators, @property decorator, Getters and Setters, RegEx, Match object, datetime, Files(Open, Read, Write, Close) and File Methods,

Learning Outcome: At the end of this Unit the student will be able to

- Interpret the advantages of advanced concepts like iterators, generator, decorators and regular expressions.
- Identify the commonly used operation involved in files for I/O processing.

TEXT BOOKS

1. Core Python programming, by W.Chun, Pearson
2. Python Programming : A Modern Approach by Vamsi Kurama, Pearson

REFERENCE BOOKS

1. 1. How To Think Like A Computer Scientist, Learning With Python, by Allen Downey, Jeffrey Elnker and Chris Meyers
2. Introduction to Python Programming, Gowrishankar S, Veena A, CRC Press/Taylor & Francis.
3. A Beginners Guide to Python 3 Programming by John Hunt, Springer

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ANALOG AND DIGITAL COMMUNICATION LABORATORY	
CODE: 23EC4205	**Credits:4**
Instruction: 3 Periods /week	Sessional Marks:50
End Exam: 3 Hours	End Exam Marks:50

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

CO1: Evaluate the performance of analog and digital modulation - demodulation techniques.

CO2: Implement analog and digital pulse modulation and demodulation methods.

CO3: Implement band pass modulation and demodulation methods.

CO4: Analyze the performance of Super Heterodyne Radio Receiver.

CO5: Simulate functional blocks of analog and digital communication system using MATLAB.

LIST OF EXPERIMENTS		
S.No.	**Name of the Experiment**	**CO**
TRAINER KIT BASED EXPERIMENTS		
1.	Amplitude Modulation and Demodulation	CO1
2.	Frequency Modulation and Demodulation	CO1
3.	Balanced Modulator & Synchronous Detector	CO1
4.	Pulse Amplitude Modulation & Demodulation	CO2
5.	Pulse Position Modulation & Demodulation	CO2
6.	Generation and Detection of Pulse Code Modulation	CO2
7.	Generation and Detection of Delta Modulation	CO2
8.	Generation and Detection of FSK	CO3
9.	Generation and Detection of DPSK	CO3
10.	Super Heterodyne Radio Receiver	CO4
SIMULATION BASED EXPERIMENTS (Open Source / MATLAB/Multisim)		
11	Amplitude Modulation and Demodulation	CO5
12	Frequency Modulation and Demodulation	CO5
13	Bit Error Rate of Amplitude Shift Keying over AWGN	CO5
14	Bit Error Rate of Phase Shift Keying over AWGN	CO5

LINEAR & DIGITAL INTEGRATED CIRCUITS LABORATORY	
ECE328	**Credits:1.5**
Instruction: 3 Practical's &1 O/week	Sessional Marks:50
End Exam: 3 Hours	End Exam Marks:50

Pre -requisites: Digital Electronics, Integrated Circuits and Applications, VHDL/Verilog Language

Course objectives:

- To understand the non-linear applications of operational amplifiers (IC741).
- To familiarize with theory and applications of IC555 timers.
- To design and construct waveform generation circuits using Op-Amp.
- To design multivibrator circuits using IC555.
- To design and analyze combinational and sequential logic circuits.

COURSE OUTCOMES:

By the end of the course student will be able to:	
CO1:	Design the circuits using op-amps for various applications like Schmitt Trigger, Precision Rectifier, Comparators and three terminal IC 78XX regulator.
CO2:	Design active filters for the given specifications and obtain their frequency response characteristics.
CO3:	Design and analyze multivibrator circuits using Op-amp and 555Timer.
CO4:	Design and Verify various combinational circuits like multiplexers, and de-multiplexers, encoder, decoder, ALU, code converters etc using FPGA.
CO5:	Design and Verify various sequential circuits like flip-flops, counters using FPGA.

Mapping of Course Outcomes with Program Outcomes&Program Specific Outcomes:

		PO												**PSO**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO	**1**	3	2	3	3				1	1	1		1			2
	2	3	2	3	3				1	1	1		1			2
	3	3	3	3	3				1	1	1		1			2
	4	3	2	3	3	2			1	1	1		1			2
	5	3	2	3	3	2			1	1	1		1			2

3: high correlation, 2: medium correlation, 1: low correlation

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
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LIST OF EXPERIMENTS

S.No	Name of the Experiment
CYCLE-I: Linear ICs	
1.	Frequency and Transient response of Op-amp in Inverting and Non-inverting modes.
2.	Design an amplifier using Op-amp for the given specifications.
3.	Measurement of Op-amp parameters.
4.	Design and verification of Op-amp adder, subtractor, Integrator, Differentiator.
5.	Design of Schmitt Trigger using op-amp.
6.	Design and verification of Active LPF & HPF using op-amp.
7.	Comparison of functionality of Astable multivibrator using a) Op-amp b) IC 555.
8.	Verification of functionality of R-2R ladder DAC.
CYCLE-II: Digital Circuits Using FPGA	
9.	Verify the functionality of parallel adder using FPGA.
10.	Verify the functionality of 4x1 Multiplexer and 1x4 Demultiplexer using FPGA.
11.	Verify the functionality of 4:2 encoder using FPGA.
12.	Verify the functionality of 3:8 decoder using FPGA.
13.	Design and verify the functionality of Binary to Gray Code converter.
14.	Verify the functionality of 2-bit Comparator using FPGA.
15.	Verify the functionality of ALU using FPGA.
16.	Verify the functionality of Mod-4 Counter using FPGA.
17.	Verify the functionality of Delay Flip flop using FPGA.

Note: A minimum of any five experiments have to be done from each cycle.

Anil Neerukonda Institute of Technology & Sciences (Autonomous)
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DESIGN THROUGH VERILOG

23EC9202 **Credits:3**

Instruction : 3 periods & 1 E/Week Sessional Marks:40

End Exam: 3 Hours End Exam Marks:60

Prerequisites: Digital Electronics, C Language, Integrated Circuits and Applications

Course Outcomes:

At the end of the course, students will be able to

1.	Outline the importance of EDA and Model logic gates, half adder, full adder ,various digital blocks by using modern tools with HDL
2.	Construct Verilog HDL models for combinational and sequential circuits using gate level, behavioral level and dataflow level
3.	Design and Analyze Sequential circuits using behavioral modeling
4.	Analyze CMOS circuits using Verilog switch level programming also implement UDPs
5.	Apply design rule checks and timing parameters to digital circuits and model the state machines

CO-PO –PSO Mapping

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

Correlation levels1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

UNIT I 10 Periods

Basics of Electronic Design Automation: VLSI Design flow, FPGA Design flow, Simulation and synthesis

Verilog Language Constructs: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches. Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks, Exercises

UNIT II 10 Periods

Gate level Modeling and Dataflow Modeling: AND Gate Primitive, Module Structure,

Other Gate Primitives, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flip-flops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Design of Basic Circuits, Exercises. Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

UNIT III 10 Periods

Behavioral Modeling: Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow. if and if-else constructs, repeat construct, for loop, , while loop, forever loop, parallel blocks, force-release construct, Event.

UNIT IV 10 Periods

Switch Level Modeling: Basic Transistor Switches, CMOS Switch, Bi-directional Gates, Time Delays with Switch Primitives, Instantiations with Strengths and Delays, Strength Contention with Trireg Nets, Exercises

System Tasks, Functions: Introduction, Parameters, Path Delays, Module Parameters, System Tasks and Functions., Compiler Directives, Hierarchical Access, General observations, Exercises.

Unit V 10 Periods

UDP, QUES and SM Charts

User-Defined Functions, Tasks and Primitives-Introduction, Function, Tasks, User-Defined Primitives (UDP), Ques FSM Design (Moore and Mealy Machines), State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Examples based on SM charts

TEXT BOOKS:

1. T.R. Padmanabhan and B. Bala Tripura Sundari," Design through Verilog HDL" WSE, IEEE Press, 2008**(UNIT-I,II,III,IV &V)**
2. J. Bhaskar" A Verilog Primier" ,First edition ,BSP, 2006**(UNIT-I,II,III,IV &V)**

REFERENCE BOOKS:

1. Brown and ZvonkoVranesic Stephen" Fundamentals of Logic Design with Verilog "TMH, 2005.
2. Michael D. Ciletti "Advanced Digital Design with Verilog HDL ",Second edition, PHI, 2005.

Numerical Ability & Professional Communication skills
(II Year II Sem.)

Course Category:	Humanities	**Credits:**	2
Branch	All Branches		
Course Code:	23TP9102	**Lecture-Tutorial-Practical:**	2+2
Prerequisites:	Knowledge of LSRW Skills, Basic Maths	**Continuous Evaluation:**	
		Semester End Evaluation:	
		Total Marks:	100

Upon successful completion of the course, the student will be able to:

Course Outcomes	**CO1**	Comprehend the essentiality of LSRW skills in paper presentations, seminars, workshops, conferences etc. with teams. **(L2),** To solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
	CO2	Attain the knowledge of soft skills in various conditions**(L3),** Solve questions based on sentence completion and fill in the blanks
	CO3	Explore diverse fields through English **(L4),** To solve different types of questions based on vocabulary, structure, grammar and verbalreasoning
	CO4	Use their logical thinking and analytical abilities to solve Quantitative aptitude questionsfrom company specific and other competitive tests.
	CO5	Solve questions related to Time and distance and time and work etc. from company specificand other competitive tests.

Contribution of Course Outcomes towards achievement of Program Outcomes& Strength of correlations

	PO1	PO2	PO3	P04	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									M	M		M		
CO2									M	M		M		
CO3									M	M		M		
CO4	M													
CO5	M													

L- Low **M-Medium** **H-High**

PART-A: Professional Communication skills

UNIT- I: Abstract Preparation – Noticing Key Words –Literature Survey – Using Academic Verbs Verbal Ability : Sentence correction	CO1
UNIT- II: Organizational Skills – Time Management – IELTS Test Papers Exercises Verbal Ability : sentence completion	CO2
UNIT- III: Meeting Skills – Arranging a Meeting – Prior to Meeting, During Meeting and After Meeting Process – Note Making – Note Taking Verbal Ability : Error Identification	CO3
UNIT- IV: Analogy – Origin of the Words – Eponyms – MNCs Question Papers Verbal Ability : vocabulary	CO3

PART-B : Numerical Ability

UNIT-I: Numerical computation-I Applications based on Numbers –Classification of Number System, Prime and Composite, Even and Odd Numbers, Divisibility Rule, Remainder Theorem, Finding Highest power, LCM &HCF	CO4
UNIT-II: Numerical estimation – I Averages, Ratio Proportion, Application of Ratios (Ages),Partnerships, Shares and dividends,	CO4
UNIT-III: Numerical estimation – II Percentages and its Applications, Profit Loss and Discount, Simple interest and Compound Interest	CO4
UNIT-IV: Numerical estimation – II Time and work, Application of Time-work (Pipes & Cisterns), Time and Distance, circular Tracking, concept of Boats & steams.	CO5
UNIT-V: Numerical computation-II Mixtures and allegations, application of percentage and Ratios and Averages in Mixtures.	CO5

FINANCIAL LITERACY							
Code	Periods			Sessional Marks	End Exam Marks	Total Marks	Credits
	L	T	P				
	30	-	-	100	-	100	-

Prerequisite: xxx

Course Objectives: The course has been designed to give familiarity with different aspects of financial literacy such as savings, investment, taxation, and insurance and understand the relevance and process of financial planning.

Course Outcomes: At the end of the course the student will be able to:	
CO-1	Recognize the role of saving money in reaching financial goals and identify components of a spending plan .
CO-2	Describe the importance of banks and their purpose as financial institutions.
CO-3	Apply the concept of investment planning.
CO-4	Ability to analyse banking and insurance products.
CO-5	Estimate Personal tax.

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

Course Outcomes	PSO1	PSO2
CO-1		
CO-2		
CO-3		
CO-4		
CO-5		

CO- Course Outcome; PO- Program Outcome; PSO-Program Specific Outcome; Level- 1: Low, 2: Medium, 3: High

SYLLABUS	
UNIT - I	**Periods: 4L+2T=6**
UNIT TITLE: Introduction to Financial Planning	
Introduction to saving: Benefits of Savings-Saving vs Investment, Investment vs Gambling-Time value of money-Management of spending and financial discipline.	
UNIT - II	**Periods: 4L+2T=6**
UNIT TITLE: Banking and Digital Payment	
Banking products and services -Savings account, Current Account, Fixed deposits, Recurring deposits-Digitisation of financial transaction- Modes of digital payments: Debit cards, Credit cards, Net banking and UPI,-Digital Wallets-Role of RBI in banking sector.	
UNIT - III	**Periods: 4L+2T=6**
UNIT TITLE: Financial Markets and Investment Planning	
Financial Markets: Primary and Secondary markets- Securities and its types, i.e., Equity, Debentures or Bonds, IPOs and FPOs-Mutual Funds: Types of Mutual Funds-Stock Market, DEMAT.	
UNIT - IV	**Periods: 4L+2T=6**
UNIT TITLE: Insurance Services: Life Insurance	
Policies- Term insurance, Endowment policies, Pension policies-Health Insurance Plans-ULIP-General Insurance-Understanding of Ponzi Schemes.	
UNIT - V	**Periods: 4L+2T=6**
UNIT TITLE: Personal Tax	
Introduction to basic tax structure in India for personal taxation-Basic concepts of Income Tax- Exemption and Deduction for individual-Income Tax Act, 1961-E-Filling.	
TEXT BOOKS:	
1.	Introduction to Financial Planning (4th Edition 2017)- Indian Institute of Banking & Finance.
2.	Sinha, Madhu. Financial Planning: A Ready Reckoner July 2017, McGraw Hill.
REFERENCE BOOKS:	
1.	Halan, Monika, Lets Talk Money: You've Worked Hard for It, Now Make It Work for You, July 2018 Harper Business.
2.	Pandit, Amar The Only Financial Planning Book that You Will Ever Need, Network 18 Publications Ltd.
WEB RESOURCES:	
1.	https://onlinecourses.nptel.ac.in/noc21_mg40/preview
2.	https://corporatefinanceinstitute.com/resources/management/financial-literacy/