Bachelor of Technology

(B.Tech.)

3rd Semester

Detailed Syllabus

2024 Batch

Department of

Electronics and Communication Engineering

NIST University, Pallur Hills, Berhampur, 761008, Odisha

www.nist.edu

Second - Year Course Structure (III Semester)							
S. No.	**Course Category**	**Course Code**	**Course Title**	**L**	**P**	**T**	**Credits**
1	BS	MTH-200	Numerical Methods and Complex Analysis	3	0	1	4
2	PC	ECE-200	Electronics Devices and Circuits	3	2	0	4
3	PC	ECE-201	Network Analysis	3	2	0	4
4	PC	ECE-202	Signal and Systems	3	2	0	4
5	ES	ECE-203	Python Programming	3	2	0	4
6	AEC	ENG-200	Soft Skill – I	1	0	0	1
7	VAC	CVL-204	Environmental Science and Engineering	1	0	0	1
							22

Professional Core Course [PC]

COURSE DESCRIPTION: Electronics Devices and Circuits

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Electronics Devices and Circuits	
Course Type	Theory	
Course Code	**ECE-200**	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	Nil
	Practice	Nil
	Total	36 Hours
Recommended Background Knowledge	Basic Electrical and Electronics Engineering	
Subject Description	The content of this course mainly deals with Analog Electronic circuits. This course typically introduces students to the principles and applications of analog electronic circuits, including amplifiers, operational amplifiers, oscillators and other essential circuit building blocks. Analog circuits, unlike their digital counterparts, deal with continuously varying signals (analog signals), meaning the voltage or current changes smoothly over time. They are built using a variety of components like resistors, capacitors, inductors, diodes, and transistors. These circuits are used for a wide range of applications, including signal conditioning, amplification, filtering, and more. This course emphasizes understanding the behavior of circuits from first principles, covering particularly FETs (Field Effect Transistors) based circuits. It balances theory with practical lab exercises, allowing students to build and test circuits to verify their performance.	

<table>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Understand the structure, basics principle of operations and applications of transistors in real life
2. Gain knowledge of various biasing techniques and develop the small-signal models to analyze the performance of amplifier circuits operating at low and high frequency
3. Design the application circuits using Operational Amplifiers (OP-AMPs)
4. Analyze the performance parameters of feedback topologies and extend the concept of feedback in design of amplifier and oscillator circuits</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Illustrate working principle of different transistors and choosing proper device depending upon application considering economic and technology up-gradation
2. Analyze various transistor biasing techniques to have excellent stabilization against internal and external parameter variations
3. Analyze the performance parameters of amplifiers operating at low and high frequency using small signal models of transistors
4. Design OP-AMP based circuits for various applications and apply various feedback topologies in design of OP-AMP based amplifier and oscillator circuits</td></tr>
<tr><td rowspan="5">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test</td><td>5 %</td></tr>
<tr><td>Course Project</td><td>5 %</td></tr>
<tr><td>Attendance</td><td>10 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 11th Edition, Pearson India Education Services Pvt. Ltd., 2015.
2. David A. Bell, “Electronic Devices and Circuits”, Oxford Higher Education Press, 5th Edition, 2010.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, “Microelectronic Circuits – Theory and Applications”, 7th Edition, Oxford University Press, 2017.
2. Donald A. Neamen, “Electronic Circuits – Analysis and Design”, 3rd Edition, McGraw Hill Education, 2006.
3. J. Milliman, C. Halkias and Satyabrata Jit, “Electronics Devices and Circuits”, 4th Edition, Mc-Graw Hill.</td></tr>
</table>

Digital Learning Resources	**Course Name**	Analog Circuit
	Course Link	https://nptel.ac.in/courses/117/101/117101106/
	Course Instructor	Prof. A. N. Chandorkar, Department of Electrical Engineering, IIT Bombay
	Course Name	Analog Electronic Circuits
	Course Link	https://nptel.ac.in/courses/108/102/108102095/
	Course Instructor	Prof. S. C. Dutta Roy, Department of Electrical Engineering, IIT Delhi

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Illustrate working principle of different transistors and choosing proper device depending upon application considering economic and technology up-gradation	PO1, PO2, PO3, PO5, PO6, PO8, PEO1, PEO2, PEO3, PEO5.
CO2	Analyze various transistor biasing techniques to have excellent stabilization against internal and external parameter variations	PO1, PO2, PO3, PO4, PO5, PO6 , PO7,,PEO1, PEO2, PEO3, PEO4.
CO3	Analyze the performance parameters of amplifiers operating at low and high frequency using small signal models of transistors	PO1, PO2, PO3, PO4, PO5, PO6,PO8, PO9, PO11, PEO1, PEO2, PEO3,

		PEO5
CO4	Design OP-AMP based circuits for various applications and apply various feedback topologies in design of OP-AMP based amplifier and oscillator circuits	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS:

Module No. 1	**Introduction to Transistors and Amplifier**	**8 Hrs**
Bipolar Junction Transistors (BJTs): Introduction, Transistor structure, Transistor Amplifying action, Modes of Operation, Configurations, Current gains of BJT, Common-Emitter characteristic **Field-Effect Transistors (FETs):** JFET - Construction, Operation, Pinch-off voltage, Drain Saturation current, Current-Voltage Characteristics, JFET as an amplifier and switch, MOSFET – Enhancement and Depletion Modes, Device Structure and Physical Operation, Threshold voltage, Regions of Operation, MOSFET Characteristics, MOSFET as amplifier and switch		

Module No. 2	**BJT amplifiers**	**10 Hrs**
DC-biasing of BJTs: Introduction, Operating point, DC load line, Fixed biased configuration, Collector feedback bias configuration, Emitter-bias configuration, Voltage-divider bias configuration, Bias stabilization of transistors **AC (small signal) analysis of BJT amplifiers:** Introduction, Low frequency model - r_e model, Low frequency analysis of Common emitter (CE) amplifier (fixed bias configuration, voltage divider bias configuration) – Input and Output		

resistance, Voltage and Current gain, Effects of R_{SIG} and R_L on CE Amplifier, Frequency response of single stage CE amplifiers, High frequency model - Hybrid-π model, Effect of Coupling and Bypass capacitors, Frequency response of single stage CE amplifiers considering high frequency model of BJT, Gain-Bandwidth product, Cascade amplifier, Cascode amplifier

Module No. 3	**MOSFET Amplifiers**	**10 Hrs**
DC-biasing of MOSFETs: DMOSFET Biasing Techniques - Constant voltage / Fixed bias, Self-bias configuration, Voltage divider biasing, Bias stabilization EMOSFET Biasing Techniques - Voltage divider biasing, Drain feedback biasing, Bias stabilization **AC (small signal) analysis of EMOSFET amplifiers:** Low frequency models, Frequency response of single stage Common Source (CS) amplifiers, Frequency response of single stage CS amplifiers considering High frequency models of EMOSFET, Miller effect capacitance, Limitations of CS amplifiers, Need of buffers, Effects of R_{SIG} and R_L on CS Amplifier, Cascade and Cascode configurations, Darlington Connection, Current Mirror Circuits		

Module No. 4	**Operational Amplifier and Feedback Topologies**	**10 Hrs**
Open-loop and Closed-loop configurations, OP-AMP application as weighted summer and Instrumentation amplifier. Concepts of negative and positive feedback, Advantage of Negative feedback, Four Basic Feedback Topologies, Principle of oscillation, OP-AMP based Sinusoidal Oscillator Circuits: Wien Bridge oscillator and R-C Phase shift oscillator.		

COURSE DESCRIPTION: Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Electronics Devices and Circuits	
Course Type	Laboratory	
Course Code	**ECE-200**	
Category	PC	
Credit Point	1	
Time Commitment	Lecture + Practice	20 Hours
	Tutorial	Nil
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Familiarization and testing of electronic components and devices, Understanding and usage of Digital Multimeters, CROs and Function Generators	
Subject Description	Analog Electronic Circuit Lab course provides hands-on experience in designing, building, and testing various analog electronic circuits like amplifiers and oscillators using discrete components like resistors, capacitors, diodes, and transistors. Students learn to design, build, test and analyze the analog circuits and use instruments like digital multimeters, oscilloscopes (CROs), function generators, and power supplies to measure input/output waveforms, voltages, currents, and other parameters. They learn to analyze the measured data, compare theoretical predictions with experimental results,	

	and draw conclusions. At the end, they engage in design and implementation of projects that apply learned concepts. In short, this lab course helps the students to apply theoretical knowledge to practical applications. This lab aims to bridge the gap between theory and practice, enhancing understanding of analog signal processing techniques and building confidence in circuit design.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Know the design procedure for choosing the most suitable biasing circuits for a given transistor 2. Gain practical idea about the limitations of an amplifier through its frequency response 3. Understand the application of OP-AMP in design of various useful practical circuits 4. Learn to apply theoretical knowledge to practical problems and develop proficiency in handling and troubleshooting analog electronic circuits	
	Outcomes: Upon completion of this course, the student will be able to: 1. Construct appropriate biasing circuits for a given transistor and understanding practical limitations of an amplifier circuit through frequency response of a given common amplification circuit 2. Develop ability to design and conduct experiments on different analog electronic circuits including amplifiers and oscillators 3. Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis 4. Acquire the relevant skills to use the techniques and modern engineering tools of electronic circuits for engineering practice	
Assessment/ Evaluation	Lab Experiments	20 %
	Record Writing	10 %
	Behavior/ Attitude	5%
	Quiz	5%
	Attendance	5%

	Final Project Presentation	50 %
	Final Viva/ Final Lab Quiz Test	5%

CO's Mapping with PO's and PEO's

Course Outcomes	**Course Outcome Statement**	**PO's / PEO's**
CO1	Construct appropriate biasing circuits for a given transistor and understanding practical limitations of an amplifier circuit through frequency response of a given common amplification circuit.	PO1, PO2, PO3, PO5, PO6, PO7, PO8, PEO1, PEO2, PEO3, PEO5.
CO2	Develop ability to design and conduct experiments on different analog electronic circuits including amplifiers and oscillators	PO1, PO2, PO3, PO4, PO5, PO7 , PO8,PO10,PEO1, PEO2, PEO3, PEO4.
CO3	Design, construct, and take measurement of various analog circuits to compare experimental results in the laboratory with theoretical analysis	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO11, PEO1, PEO2, PEO3, PEO5
CO4	Acquire the relevant skills to use the techniques and modern engineering tools of electronic circuits for engineering practice	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	Construct and compare the performance of BJT bias circuits (namely fixed bias, collector feedback bias and voltage-divider bias circuits) in terms of their stability factors	2 Hours
2	Determine the input & output impedance and gain of a single stage CE amplifier	2 Hours
3	Study the single stage CE amplifier and find the gain-bandwidth product from its frequency response	2 Hours
4	Design, assemble & test and compare the performances of JFET bias circuits (fixed bias and self-bias circuits)	2 Hours
5	Determine the drain and transfer characteristics of a JFET & calculate the drain resistance, amplification factor and the transconduntance of the given JFET	2 Hours
6	Study the frequency response of a single stage CS FET amplifier and find the bandwidth of the amplifier circuit	2 Hours
7	Construct and test Differentiator and Integrator circuit using OP-AMP	2 Hours
8	Design and test a Wein-Bridge oscillator circuit using OP-AMP to produce sinusoidal waveforms of different amplitudes and frequencies	2 Hours
9	Design and test a RC phage shift oscillator circuit using OP-AMP to produce sinusoidal waveforms of different amplitudes and frequencies	2 Hours
10	Design, assemble and test of Darlington connection and a current mirror circuit	2 Hours

COURSE DESCRIPTION: Network Analysis

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Network Analysis	
Course Type	Theory	
Course Code	**ECE-201**	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	0 Hours
	Practice	12 Hours
	Total	48 Hours
Recommended Background Knowledge	Electrical System Around us	
Subject Description	The subject gives an overview of network analysis techniques, Transient and steady state sinusoidal response. Network graphs and their applications in network analysis. Two-port networks, combination of two ports, Analysis of common two ports, Resonance, Coupled circuits, Network functions, parts of network functions, obtaining a network function from a given part. Elements of network synthesis techniques.	

Outcomes	**Outcomes:** 1. Understanding the structure of complex circuits using network Topology 2. Obtain the transient and steady-state response of electrical circuits. 3. Understanding and calculating parameters for two-port networks, which are essential for analyzing interconnected systems. 4. Potentially exploring techniques to synthesize one-port networks from given impedance or admittance functions.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	5 %
	Academic Project	5 %
	Attendance	10 %
	End-Term Examination	50 %
Prescribed Text Book(s)	[1] Fundamentals of Electric Circuits – Alexander & Sadiku – Tata McGraw Hill, 5th Edition. [2] Network Analysis and Synthesis– M E Van Valkenburg – Pearson Education, 3rd Edition.	
Reference Book(s)	[1] Theory and problem of electrical circuits, Schaum's Outline Series, TMH – Joseph A. Edminister, Mahmood Maqvi. [2] Network theory, Sudhakar and Shymmohan, TMH Publications. [3] W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013	
Digital Learning Resources		

1.	Circuit Theory by Prof. S.C.Dutta Roy, Professor, IIT Delhi https://archive.nptel.ac.in/courses/108/102/108102042/	**NPTEL**
2.	Network Analysis by Prof. Tapas Kumar Bhattacharya, Professor, IIT Kharagpur	**NPTEL**

		https://archive.nptel.ac.in/courses/108/105/108105159/	
	3.	Basic Electric Circuits by Dr. Ankush Sharma https://archive.nptel.ac.in/courses/108/104/108104139/	**NPTEL**

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Understanding the structure of complex circuits using network Topology.	PO1,PO2
CO2	Obtain the transient and steady-state response of electrical circuits.	PO1
CO3	Understanding and calculating parameters for two-port networks, which are essential for analyzing interconnected systems	PO1,PO2,PO3
CO4	Potentially exploring techniques to synthesize one-port networks from given impedance or admittance functions	PO1,PO2

DETAILED SYLLABUS:

Module - 1	Network Topology and Coupled Circuits	08 Hours
Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule. Analysis of dc and AC circuits with independent and dependent sources: Reciprocity theorem, Compensation theorem, Milliman's theorem Coupled Circuits: Self-inductance and Mutual inductance, Coefficient of coupling, dot convention, Ideal Transformer, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits.		

Module No. 2	Laplace transform and its Application Electrical circuits	10 Hours
. **Electrical Circuit Analysis Using Laplace Transforms:** Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. **Transient analysis of electrical circuits using Laplace Transforms:** First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, Evaluating initial conditions procedure, second order differential equations, homogeneous, non- homogenous, problem solving using R-L-C elements with DC excitation and AC excitation,		

Module No. 3	Two Port Network and Network Functions:	9 Hours
Two Port Networks: Relationship of two port networks, Z-parameters, Y- parameters, Transmission line parameters, h-parameters, Inverse h- parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving		

including dependent sources also. **Network functions:** Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behavior from Pole-Zero plots.

Module No. 4	Fourier series & its Application, and Network Synthesis:	9 Hours
Fourier series & its Application: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions, Parsvel's theorem. **Network Synthesis:** Realizability concept, Hurwitz property, positive realness, and properties of positive real functions. Synthesis of R-L, R-C and L-C driving point functions in Foster and Cauer forms		

COURSE DESCRIPTION: Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Network Analysis	
Course Type	Laboratory	
Course Code	**ECE-201**	
Category	PC	
Credit Point	1	
Time Commitment	Lecture	Nil
	Tutorial	Nil
	Practice	20 Hours
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics Circuits	
Subject Description	Network Theory Lab is a practical course where students learn to analyze and design electrical circuits using fundamental concepts and theorems. It involves hands-on experience with circuit construction, measurement, and verification of theoretical principles. The lab focuses on understanding network behavior in both steady-state and transient conditions	
Outcomes	**Outcomes:** 1. Apply Network theorems for the analysis of electrical circuits. 2. Obtain the Steady state and transient response of electrical circuits 3. Obtain frequency repose of the electrical circuits. 4. Analyze two port circuit behavior, Filter circuits.	

Assessment/ Evaluation	Lab Experiments	20%
	Record Writing	10%
	Behavior/ Attitude	05%
	Quiz	10%
	Attendance	05%
	Final Lab Test	30%
	Final Viva/ Final Lab Quiz Test	20%
Prescribed Text Book(s)	[1] S. Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013. [2] G. Rizzoni, "Principles and Applications of Electrical Engineering", McGrawHill, 2017	
Digital Learning Resources		

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Apply Network theorems for the analysis of electrical circuits	PO1, PO2, PO3, PO4, PO5
CO2	Obtain the Steady state and transient response of electrical circuits	PO1, PO2, PO3, PO5
CO3	Obtain frequency repose of the electrical circuits.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze two port circuit behavior, Filter circuits	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Duration in Hrs
1	Verification of Network Theorems in DC circuits. (Reciprocity theorem, , Milliman's theorem & Compensation Theorem).	2
2	Verification of Network Theorems in AC circuits. (Superposition theorem, Reciprocity theorem, Maximum Power transfer theorem).	2
3	Study of DC and AC Transients for R-L, R-C & R-L-C circuits using storage oscilloscope.	2
4	Determination of two port network parameters.	2
5	Frequency response of Low pass and High Pass Filters.	2
6	Frequency response of Band pass and Band Elimination Filters	2
7	Determination of self inductance, mutual inductance and coupling coefficient of a single phase two winding transformer representing a coupled circuit	2
8	Study of resonance in R-L-C series and R-L-C Parallel circuit using oscilloscope	2
9	Determine the frequency response of Series RLC and Parallel RLC circuit Using MATLAB Simulink	2
10	Determination of Response of different DC circuits using MATLAB	2

COURSE DESCRIPTION: Signal and Systems

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Signal and Systems	
Course Type	Theory	
Course Code	**ECE-202**	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	Nil
	Practice	Nil
	Total	36 Hours
Recommended Background Knowledge	Basics of Fourier Series, Fourier Transform	
Subject Description	This course introduces fundamental concepts of signals and systems with a focus on both continuous-time (CT) and discrete-time (DT) domains. It covers signal classifications, system properties, convolution and correlation operations, and essential analytical tools such as Fourier Series, Fourier Transform, and Laplace Transform. Emphasis is placed on mathematical modeling, signal analysis, and system behavior understanding for applications in communication, control, and signal processing.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 5. Impart a foundational understanding of various types of signals and their mathematical operations. 6. Introduce the analysis and classification of linear time-invariant (LTI)	

	systems in both CT and DT domains. 7. Develop the ability to analyze signals and systems using Fourier Series and Fourier Transform. 8. Provide knowledge of Laplace Transform techniques for solving and analyzing differential equations in system modeling.	
	Outcomes: Upon completion of this course, the student will be able to: 1. Classify and analyze various types of continuous-time and discrete-time signals. 2. Determine and evaluate properties of systems including linearity, time-invariance, causality, and stability. 3. Apply Fourier Series and Fourier Transform to analyze and interpret signal behaviors in the frequency domain. 4. Utilize Laplace Transform for solving differential equations and analyzing system dynamics in the s-domain.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test	5 %
	Course Project	5 %
	Attendance	10 %
	End-Term Examination	50 %
Prescribed Text Book(s)	[1] Tarun Kumar Rawat, Signals and Systems, 1st edition, Oxford University Press, 2010, India. [2] A. Nagoor kani, Signals and Systems, 2nd edition, Tata McGraw Hill Education Private Limited, 2010, New Delhi. [3] Signals & systems by Alan V Oppenheim Publisher Upper Saddle River, N.J. : Prentice Hall	
Reference Book(s)	[1]. I.J. Nagrath, S. N. Sharan, and R. Ranjan, S. Kumar, *Signals and Systems*, 2nd Edition, Tata McGraw Hill Education Private Limited, 2001, New Delhi. [2]. Ramesh Babu , *Signals and Systems*, 4th edition, Scitech Publication, 2010, India.	
Digital Learning Resources	**Course Name**	*Signals and Systems*

	Course Link	*https://onlinecourses.nptel.ac.in/noc21_ee28/preview*
	Course Instructor	*Prof. Kushal K. Shah, IISER Bhopal*
	Course Name	*Principles of Signals and Systems*
	Course Link	*https://archive.nptel.ac.in/courses/108/104/108104100/*
	Course Instructor	*Prof. Aditya K. Jagannatham, IIT Kanpur*

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Classify and analyze various types of continuous-time and discrete-time signals.	PO1, PO2, PO3, PO5, PO9,PEO1, PEO2, PEO4
CO2	Determine and evaluate properties of systems including linearity, time-invariance, causality, and stability.	PO1, PO2, PO3, PO4,PO5, PO9 ,PEO1, PEO2, PEO5
CO3	Apply Fourier Series and Fourier Transform to analyze and interpret signal behaviors in the frequency domain.	PO1, PO2, PO3, PO4,PO5, PO6,PO7, PEO1, PEO2, PEO4
CO4	Utilize Laplace Transform for solving differential equations and analyzing system dynamics in the s-domain.	PO1, PO2, PO3, PO4, PO5, PO6, PEO1, PEO2, PEO4, PEO5

DETAILED SYLLABUS:

Module No. 1	**Introduction to Signals: Continuous and Discrete Time Signals**	**9 Hrs**
Basics of continuous-time (CT) and discrete-time (DT) signals. Classification of signals: energy, power, periodic, aperiodic, even, odd, causal, anti-causal, and standard signals. Basic operations on signals: amplitude and time scaling, time shifting, folding, addition, and multiplication.		

Module No. 2	**Introduction to Systems: Continuous and Discrete Time Systems**	**9 Hrs**
Classification of continuous-time and discrete-time systems: linear, non-linear, time-invariant, time-varying, causal, non-causal, stable, unstable, static, and dynamic systems. Convolution sum and integral for LTI systems. Properties of LTI systems. Basics of correlation and difference with convolution.		

Module No. 3	**Continuous Time Fourier Series and Fourier Transform**	**9 Hrs**
Introduction to Fourier Series: trigonometric and exponential forms, properties. Fourier Transform for CT signals: FT of aperiodic and periodic signals, convergence, properties, and system analysis using FT. Concepts of energy and power spectral density.		

Module No. 4	**Laplace Transform and Sampling Theorem**	**9 Hrs**
Introduction to complex frequency (S-domain). Definition and conditions for existence of Laplace and inverse Laplace transforms. Key theorems, differentiation and integration in Laplace domain. Transforms of standard functions. Initial and final value theorems. **Sampling Theorem:** Introduction to Sampling Theorem and Reconstruction of Continuous-Time Signals from Samples		

COURSE DESCRIPTION: Laboratory

<table>
<tr><td>Degree</td><td colspan="2">B. Tech.</td></tr>
<tr><td>Level</td><td colspan="2">Undergraduate</td></tr>
<tr><td>Branch</td><td colspan="2">ECE (Electronics and Communication Engineering)</td></tr>
<tr><td>Semester</td><td colspan="2">3rd</td></tr>
<tr><td>Subject Name</td><td colspan="2">Signal and Systems</td></tr>
<tr><td>Course Type</td><td colspan="2">Laboratory</td></tr>
<tr><td>Course Code</td><td colspan="2">ECE-202</td></tr>
<tr><td>Category</td><td colspan="2">PC</td></tr>
<tr><td>Credit Point</td><td colspan="2">1</td></tr>
<tr><td rowspan="3">Time Commitment</td><td>Practice</td><td>20 Hours</td></tr>
<tr><td>Tutorial</td><td>Nil</td></tr>
<tr><td>Total</td><td>20 Hours</td></tr>
<tr><td>Recommended Background Knowledge/Course Pre-requisites</td><td colspan="2">Knowledge in Matlab/ Python</td></tr>
<tr><td>Subject Description</td><td colspan="2">This laboratory course aims to provide practical exposure to fundamental concepts in Signals and Systems using MATLAB/Python as a simulation tool. Students will learn to generate and analyze continuous-time (CT) and discrete-time (DT) signals, apply convolution and correlation techniques, and explore transformations like Fourier Series and Laplace Transforms. The course emphasizes algorithmic thinking and the use of MATLAB/Python programming for solving signal processing problems.</td></tr>
<tr><td>Objectives and Outcomes</td><td colspan="2">Objectives:
The course should enable the students to:
1. Familiarize with MATLAB/Python-based signal representation and manipulation.
2. Enable to generate and visualize CT and DT signals and perform basic signal operations.</td></tr>
</table>

	3. Impart hands-on experience in implementing linear convolution and correlation for system analysis. 4. Provide computational techniques for solving signals using Fourier Series and Laplace Transforms.
	Outcomes: Upon completion of this course, the student will be able to: 1. Implement signal generation and perform matrix manipulations using MATLAB/Python. 2. Analyze the behavior of CT and DT signals through convolution and correlation techniques. 3. Apply computational methods to evaluate Fourier Series and Laplace transforms of signals. 4. Develop MATLAB/Python programs for simulation and visualization of signal processing concepts.

Assessment/ Evaluation	Lab Experiments	20 %
	Record Writing	10 %
	Behavior/ Attitude	5%
	Quiz	5%
	Attendance	5%
	Final Project Presentation	50 %
	Final Viva/ Final Lab Quiz Test	5%

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Implement signal generation and perform matrix manipulations using MATLAB/Python.	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PEO1, PEO2, PEO4, PEO5
CO2	Analyze the behavior of CT and DT signals through convolution and correlation techniques.	PO1, PO2, PO3, PO4, PO5, PO7,

		PO8, PO9 ,PEO1, PEO2, PEO5
CO3	Apply computational methods to evaluate Fourier Series and Laplace transforms of signals.	PO1, PO2, PO3, PO4,PO5, PO6, PO7, PO8, PO9, PEO1, PEO2, PEO4
CO4	Develop MATLAB/Python programs for simulation and visualization of signal processing concepts.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO10, PEO1, PEO2, PEO4, PEO5

DETAILED SYLLABUS (EXPERIMENTS): The experiment should be performed in MATLAB or PYTHON

Sl. No.	Name of Experiments	Durations
1	Creation of arrays and matrices in simulator and their manipulation	2 Hours
2	Use of control structures and writing of programs and function	2 Hours
3	Generation and plotting of various continuous time signals	2 Hours
4	Generation and plotting of various discrete time signals	2 Hours
5	Linear Convolution of CT signals	2 Hours
6	Linear Convolution of DT signals	2 Hours
7	Linear Correlation of CT signals.	2 Hours
8	Linear Correlation of DT signals.	2 Hours
9	Computation of trigonometric Fourier Series of CT periodic signals	2 Hours
10	Computation of Laplace transform and Inverse Laplace Transform of signals	2 Hours

COURSE DESCRIPTION: Python Programming

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Python Programming	
Course Type	Theory	
Course Code	**ECE-203**	
Category	PC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	Nil
	Practice	Nil
	Total	36 Hours
Recommended Background Knowledge	Basics of programming	
Subject Description	This course will give the student a fundamental knowledge of Python. It is designed for beginners. The content has been carefully made to be bite-sized, simple, and easy to understand. The syllabus outline and its sequence are structured so that the students can learn Python step by step, from the introduction, to creating their first application with Python.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Identify/characterize/define a problem. 2. Design a program to solve the problem. 3. Create executable code. 4. Read most Python code and write basic unit tests.	

<table>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. To introduce students to Python programming environment and its basic syntax.
2. To familiarize students with Python data types, variables, and operators.
3. To enable students to write modular and reusable code using functions.
4. To develop understanding of object-oriented programming, file handling and error management in Python.</td></tr>
<tr><td rowspan="5">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test</td><td>5 %</td></tr>
<tr><td>Course Project</td><td>5 %</td></tr>
<tr><td>Attendance</td><td>10 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Reema Thareja, Python Programming, Oxford Publications.
2. Mark Lutz, O'Reilly, Learning Python.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Tommy Löfstedt, Statistics and Machine Learning in Python Release 0.1, Edouard Duchesnay, Tommy Löfstedt
2. Fabio Nelli, Python Data Analytics, A Press.</td></tr>
<tr><td rowspan="3">Digital Learning Resources</td><td>Course Name</td><td>Programming Data Structures and Algorithms in Python</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/106/106/106106145/</td></tr>
<tr><td>Course Instructor</td><td>Prof. Madhavan Mukund, Chennai Mathematical Institute</td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	To introduce students to Python programming environment and its basic syntax.	PO1, PO2, PO3, PO5, PO6, PO8, PEO1, PEO2, PEO3, PEO5.

CO2	To familiarize students with Python data types, variables, and operators.	PO1, PO2, PO3, PO4, PO5, PO6 , PO7,,PEO1, PEO2, PEO3, PEO4.
CO3	To enable students to write modular and reusable code using functions.	PO1, PO2, PO3, PO4, PO5, PO6,PO8, PO9, PO11, PEO1, PEO2, PEO3, PEO5
CO4	To develop understanding of object-oriented programming, file handling and error management in Python.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS:

Module No. 1		**8 Hrs**
Introduction to Python Programming Language: Introduction to Python Language and installation, interpreters and complier, Numeric Data Types: int, float, Boolean, complex and string and its operations, Standard Data Types: List, tuple, set and Dictionaries, Data Type conversions, commenting in python.		

Module No. 2		**10 Hrs**
Variables and Operators: Understanding Python variables, Multiple variable declarations, Python basic statements, Python basic operators: Arithmetic operators, Assignment operators, Comparison operators, Logical operators, Identity operators, Membership operators, Bitwise operators, Precedence of operators, Expressions. **Control Flow and Loops:** Conditional (if), alternative (if-else), chained conditional (if- elif - else), Loops: For loop using ranges, string, Use of while loops in python, Loop manipulation using pass, continue and break.		

Module No. 3		**10 Hrs**
Functions: Defining Your Own Functions, Calling Functions, passing parameters and arguments, Python Function arguments: Keyword Arguments, Default Arguments, Variable length arguments, Anonymous Functions, Fruitful Functions, Scope of the Variables in a Function - Global and Local Variables. Powerful Lambda functions in python.		

Module No. 4		**10 Hrs**
Object Oriented Programming: Class and Object, Defining variables and functions inside class, Creating objects, Inheritance, Inheritance, Encapsulation, Polymorphism, Abstraction. **I/O and Error Handling in Python:** Introduction, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods introduction to Errors and Exceptions, Handling IO Exceptions, Run Time Errors, Handling Multiple Exceptions.		

COURSE DESCRIPTION: Laboratory

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	3rd	
Subject Name	Python Programming	
Course Type	Laboratory	
Course Code	**ECE-203**	
Category	PC	
Credit Point	1	
	Lecture + Practice	20 Hours

Time Commitment	Tutorial	Nil
	Total	20 Hours
Recommended Background Knowledge/Course Pre-requisites	Basics of programming	
Subject Description	This laboratory will give the student a fundamental knowledge of Python programming. It is designed for beginners. The content has been carefully made to be bite-sized, simple, and easy to understand. The syllabus outline and its sequence are structured so that the students can learn Python programming step by step, from the introduction, to creating their first application with Python.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. To write, test, and debug simple Python programs. 2. To implement Python programs with conditionals and loops. 3. Use functions for structuring Python programs. 4. Represent compound data using Python lists, tuples, and dictionaries.	
	Outcomes: Upon completion of this course, the student will be able to: 1. Write, test, and debug simple Python programs. 2. Implement Python programs with conditionals and loops. 3. Develop Python programs step-wise by defining functions and calling them. 4. Use Python lists, tuples, dictionaries for representing compound data.	
Assessment/ Evaluation	Lab Experiments	20 %
	Record Writing	10 %
	Behavior/ Attitude	5%
	Quiz	5%
	Attendance	5%
	Final Project Presentation	50 %

	Final Viva/ Final Lab Quiz Test	5%

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Write, test, and debug simple Python programs.	PO1, PO2, PO3, PO5, PO6, PO7, PO8, PEO1, PEO2, PEO3, PEO5.
CO2	Implement Python programs with conditionals and loops.	PO1, PO2, PO3, PO4, PO5, PO7 , PO8,PO10,PEO1, PEO2, PEO3, PEO4.
CO3	Develop Python programs step-wise by defining functions and calling them.	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO11, PEO1, PEO2, PEO3, PEO5
CO4	Use Python lists, tuples, dictionaries for representing compound data.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO9, PO10, PEO1, PEO2, PEO3, PEO4, PEO5

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	a) Demonstrate about Basics of Python Programming. b) Demonstrate about fundamental Data types in Python	2 Hours

	Programming. (i.e., int, float, complex, bool and string types)	
2	b) Demonstrate the working of following functions in Python. (type(), range()) b) Demonstrate the Operators in Python with suitable examples.	2 Hours
3	a) Write Python programs to demonstrate print(). b) Demonstrate the Conditional statements in Python with suitable examples	2 Hours
4	a) Demonstrate the Iterative statements in Python with suitable examples. b) Demonstrate the control transfer statements in Python with suitable examples (break, continue and pass)	2 Hours
5	a) Write Python programs to print different Patterns. b) Write a Python program to demonstrate various ways of accessing the string. I) Indexing (positive and negative) II) Slice operation	2 Hours
6	b) Demonstrate the functions/methods which operate on strings in Python with suitable examples. b) Demonstrate the functions/methods which operate on lists in Python with suitable examples.	2 Hours
7	b) Demonstrate the functions/methods which operate on tuple in Python with suitable examples. b) Demonstrate the functions/methods which operate on set in Python with suitable examples.	2 Hours
8	b) Demonstrate the functions/methods which operate on dictionary in Python with suitable examples. b) Demonstrate the kinds of Parameters used while writing functions in Python.	2 Hours
9	a) Create classes with attributes and methods. Instantiate objects and access their attributes in Python with suitable examples. b) Demonstrate single and multilevel inheritance with real-world class examples, along with encapsulation and method overriding in Python with suitable examples	2 Hours
10	a) Simulation and Logging of Body Temperature Data using Python b) Design of a Console-Based Medicine Reminder System using Python	2 Hours

For CSE

3rd Semester Course

COURSE DESCRIPTION: Digital Logic Design

Degree	B. Tech.
Level	Undergraduate
Branch	CSE (Computer Science and Engineering)
Semester	3rd
Subject Name	Digital Logic Design
Course Type	Theory
Course Code	ECE-200
Category	ESC (ENGINEERING SCIENCE COURSE)

<table>
<tr><td>Credit Point</td><td colspan="2">3</td></tr>
<tr><td rowspan="4">Time Commitment</td><td>Lecture</td><td>36 Hours</td></tr>
<tr><td>Tutorial</td><td>Nil</td></tr>
<tr><td>Practice</td><td>Nil</td></tr>
<tr><td>Total</td><td>36 Hours</td></tr>
<tr><td>Recommended Background Knowledge</td><td colspan="2">Basics of Digital Electronics</td></tr>
<tr><td>Subject Description</td><td colspan="2">The Digital Revolution marked the beginning of the Information Age. Adoption of digital computers and digital data storage devices followed by development of Semiconductors leverage the digital technology to touch all the needs of society. In this course, the basic building blocks like gates and their uses to design logic function is discussed followed by function simplification using Boolean algebra and Mapping method. The course postulates the fundamental blocks like combinational and sequential logic circuits to design complex Digital systems. The inherited knowledge cited here applied for Digital VLSI technology enables the invention of robust digital systems those are used for the whole mankind in all walks of life.</td></tr>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Provide insight about the requirement of designing low cost and high speed Digital circuits.
2. Gain inclusive knowledge about combinational logic circuits.
3. Acquire fundamental knowledge about memory and their application towards sequential circuit.
4. Get the idea of designing synchronous and asynchronous circuits.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:
1. Acquire fundamental knowledge about Digital electronics and the simplification of logic function using Boolean laws and mapping methods.
2. Understand the behavior of combinational arithmetic and logic circuits</td></tr>
</table>

	for development of complex digital systems **3.** Acquire fundamental knowledge of flip flops and latches and their use for designing synchronous sequential circuits. **4.** Understand the procedure to design Asynchronous counters and shift registers	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test	5 %
	Course Project	5 %
	Attendance	10 %
	End-Term Examination	50 %
Prescribed Text Book(s)	M. Morris Mano, Michael D Ciletti, *Digital Design*, 5th Edition, Pearson Publication, 2016, New Delhi.	
Reference Book(s)	1. Donald P Leach, Albert Paul Malvino, GoutamSaha , *Digital Principles And Applications*, 8th Edition ,Tata McGraw Hill Education, 2015, New Delhi. 2. A Anand Kumar, *Fundamentals of digital circuits*, 4th edition, PHI, 2016, New Delhi. 3. T.L. Floyd and R.P. Jain, *Digital Fundamentals*, 7th Edition, Pearson Education, 2005, Bangalore 4. Norman Balabanian& Bradley Carlson, *Digital Logic Design Principles*, 2nd edition, John Wiley & Sons, 2004, New York.	
Digital Learning Resources	**Course Name**	Digital Circuit and System
	Course Link	https://nptel.ac.in/courses/117106086/
	Course Instructor	Prof. S. Srinivasan, Department of Electrical Engineering, IIT Madras.
	Course Name	**Digital Circuits**
	Course Link	https://nptel.ac.in/courses/117103064/
	Course	Prof. Anil Mahanta, Prof. Roy Paily Palanthinkal , IIT

	Instructor	Guwahati

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Acquire fundamental knowledge about Digital electronics and the simplification of logic function using Boolean laws and mapping methods	PO1, PO2, PO3, PO4
CO2	Understand the behavior of combinational arithmetic and logic circuits for development of complex digital systems	PO1, PO2, PO3, PO4,PO5, PO6,PO7
CO3	Acquire fundamental knowledge of flip flops and latches and their use for designing sequential circuits	PO1, PO2, PO3, PO4,PO5, PO6,PO7
CO4	Understand the procedure to design Asynchronous counters and shift registers	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Digital Fundamentals and Binary Codes**	**(10 Hours)**
Arithmetic Operation using 1’s and 2`s Complements, Binary codes(Gray and BCD), Min-terms and Max-terms, Canonical Logic Forms, Extracting Canonical Forms, Function implementation: using basic logic gates, Using only universal gates, K-Maps: Two, Three and Four variable K-maps.		

Module No. 2	**Combinational Logic Design**	**(10 Hours)**
Arithmetic Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor, 4-bit Binary		

Parallel Adder, Multiplier(up to 3-bit), Magnitude Comparator(up to 2-bit). **Logic Circuits:** Gray to Binary and Binary to Gray Code Converters, Multiplexer, De-Multiplexer, Decoder, Encoder, Priority encoder

Module No. 3	**Fundamentals of Sequential Circuits**	**(6 Hours)**
Storage elements, Latches(SR and D), Flip-Flops, Analysis of Flip-Flops: Functional Table, Characteristic Table, Characteristic Equation, State Diagram, Excitation Table, Positive-Edge-Triggered D Flip-Flop, Master-Slave JK-FF, Flip-Flop conversions.		

Module No. 4	**Sequential Circuits Design**	**(10 Hours)**
Digital counters: Design Procedure, Counter: Asynchronous and Synchronous Counter **FSM Fundamentals:** Melay and Moore Machines, **Shift Registers:** Shifting of Binary Bits, SISO, SIPO, PISO, PIPO **Fundamentals of logic family**: DTL (Diode-Transistor Logic)**,** TTL (Transistor-Transistor Logic).		

COURSE DESCRIPTION: Laboratory

Degree	B. Tech.
Level	Undergraduate
Branch	CSE (Computer Science and Engineering)
Semester	3rd Semester
Subject Name	**Digital Logic Design**
Course Type	Laboratory

<table>
<tr><td>Course Code</td><td colspan="2">ECE-200</td></tr>
<tr><td>Category</td><td colspan="2">ESC (ENGINEERING SCIENCE COURSE)</td></tr>
<tr><td>Credit Point</td><td colspan="2">1</td></tr>
<tr><td rowspan="3">Time Commitment</td><td>Lecture + Practice</td><td>20 Hours</td></tr>
<tr><td>Tutorial</td><td>Nil</td></tr>
<tr><td>Total</td><td>20 Hours</td></tr>
<tr><td>Recommended Background Knowledge/Course Pre-requisites</td><td colspan="2">Basics of Digital logic</td></tr>
<tr><td>Subject Description</td><td colspan="2">The modern era belongs to digital technology. The design of electronic gadgets leverages the uses of digital domain in all walks of life. This course is planned to provide practical, hands-on experience in designing, implementing, and verifying digital circuits. This involves learning and applying concepts like Boolean algebra, combinational and sequential logic and using digital ICs. The lab aims to equip students with the skills to design systems that meet specific requirements and solve engineering problems using digital circuits.</td></tr>
<tr><td rowspan="2">Objectives and Outcomes</td><td colspan="2">Objectives:
The course should enable the students to:
1. Understand the uses of basic digital integrated circuits
2. Grasp the concept of designing digital circuits in a lab environment
3. Familiar with design and testing of various combinational circuits
4. Know the design, implementation and debugging of sequential circuits</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:
1. Access knowledge about various fundamental digital Integrated circuits and bread board
2. Understand the digital design flow in real time environment</td></tr>
</table>

	3. Design combinational circuits using different logic gates, Multiplexer and decoder ICs 4. Design sequential circuits using different types of flip flops	
Assessment/ Evaluation	Lab Experiments	20 %
	Record Writing	10 %
	Behavior/ Attitude	5%
	Quiz	5%
	Attendance	5%
	Final Project Presentation	50 %
	Final Viva/ Final Lab Quiz Test	5%

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Access knowledge about various fundamental digital Integrated circuits and bread board	PO1, PO2, PO3, PO4, PO8, PO9, PO10, PO12
CO2	Understand the digital design flow in real time environment	PO1, PO2, PO3, PO4, PO6. PO8, PO9, PO10, PO12

CO3	Design combinational circuits using different logic gates, Multiplexer and decoder ICs	PO1, PO2, PO3, PO4, PO6. PO8, PO9, PO10, PO12
CO4	Design sequential circuits using different types of flip flops	PO1, PO2, PO3, PO4, PO6. PO8, PO9, PO10, PO12

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, and Inverter gates.	2 Hours
2	Gate-level minimization: Two level and multi-level implementation of Boolean functions.	2 Hours
3	Design and Testing of combinational circuits: Half-Adder, Half-Subtraction, and Full Adder.	2 Hours
4	Design of binary to Gray, Gray to Binary Code Converter, and Seven Segment Display Decoder.	2 Hours
5	Design and implementation of 2-bit Binary Multiplier	2 Hours
6	Testing of Multiplexer and function implementation using suitable Multiplexer	2 Hours
7	Testing of Decoder and function implementation using suitable Decoder.	2 Hours
8	Testing of basic SR Latch and FFs: D-FF, JK-FF	2 Hours
09	Design and Testing of SISO, SIPO Shift Registers	2 Hours
10	Design and testing of 3-bit binary Asynchronous UP-Counter and Modulo-6 counter.	2 Hours