NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC

Accredited by NAAC with 'A' Grade, Accredited by NBA

The Trust is a Recipient of Prestigious Rajyotsava State Award 2012 Conferred by the Government of Karnataka

Awarded Outstanding Technical Education Institute in Karnataka

Ring Road, Bellandur Post, Near Marathalli, Bangalore -560 103, INDIA

Academic Year 2019-20

ECE - Electronics & Communication Engineering

Fifth and Sixth Semesters
Scheme and Syllabus

CONTENTS

VISION

To create high quality engineering professionals who can serve the society and earn global recognition.

MISSION

- To build strong foundation in Electronics and Communication Engineering aspects by exposing students to state of the art technology and research.
- To strengthen the curriculum through interaction with industry experts to equip the students with the required competency.
- To mould students to share technical knowledge and to practice professional and moral values.

Program Education objectives (PEOs)

PEO1	To produce graduates with understanding of fundamentals and applications of Electronics and Communication Engineering.
PEO2	To hone graduates with ability to apply, analyze, design and develop electronic systems.
PEO3	To enhance graduates with latest technologies to enable them to engineer products for real world problems.
PEO4	To build leadership qualities, management skills, communication skills, moral values, team spirit and lifelong learning ability for the graduates.

PEO to Mission Statement Mapping

Mission Statements	**PEO1**	**PEO2**	**PEO3**	**PEO4**
To build strong foundation in Electronics and Communication Engineering aspects by exposing students to state of the art technology and research.	3	3	3	2
To strengthen the curriculum through interaction with industry experts to equip the students with the required competency.	2	3	3	2
To mould students to share technical knowledge and to practice professional and moral values.	1	2	2	3

Correlation: 3- High, 2-Medium, 1-Low

Program Outcomes (PO) with Graduate Attributes

	Graduate Attributes	Program Outcomes (POs)
1	**Engineering knowledge**	**PO1:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems in Electronics and Communication Engineering.
2	**Problem analysis**	**PO2:** Identify, formulate, review research literature, and analyze complex engineering problems in Electronics and Communication Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	**Design/development of solutions**	**PO3:** Design solutions for complex engineering problems and design system components or processes of Electronics and Communication Engineering that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	**Conduct investigations of complex problems**	**PO4:** Use research-based knowledge and research methods including design of experiments in Electronics and Communication Engineering, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	**Modern tool usage**	**PO5:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities in Electronics and Communication Engineering with an understanding of the limitations.
6	**The engineer and society**	**PO6:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice in Electronics and Communication Engineering.
7	**Environment and sustainability**	**PO7:** Understand the impact of the professional engineering solutions of Electronics and Communication Engineering in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	**Ethics**	**PO8:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	**Individual and team**	**PO9:** Function effectively as an individual, and as a member or leader in

	work	diverse teams, and in multidisciplinary settings.
10	**Communication**	**PO10:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	**Project management and finance**	**PO11:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	**Life-long learning**	**PO12:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

PSO1	To demonstrate the ability to design and develop complex systems in the areas of next generation Communication Systems, IoT based Embedded Systems, Advanced Signal and Image Processing, latest Semiconductor technologies, RF and Power Systems.
PSO2	To demonstrate the ability to solve complex Electronics and Communication Engineering problems using latest hardware and software tools along with analytical skills to contribute to useful, frugal and eco-friendly solutions.

Mapping of PEOs to POs & PSOs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
PEO1	3	3	2	2	2	1	1	1	1	1	1	1	1	1
PEO2	3	3	3	3	3	2	2	2	2	2	2	2	3	2
PEO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
PEO4	1	1	1	1	1	2	2	3	3	3	3	3	1	1

Correlation: 3- High, 2-Medium, 1-Low

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2017 -2021

Department of Electronics and Communication Engineering

Scheme of Fifth and Sixth Semester

Third Year / Fifth Semester													
Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE51	Analog Communication	3	2	0	0	5	3	4	75	75	150
2	ECE52	Microcontrollers	3	2	0	0	5	3	4	75	75	150
3	ECE53	CMOS VLSI Design	3	2	0	0	5	3	4	75	75	150
4	ECE54	Information Theory and Coding	3	0	0	0	3	4	0	50	50	100
5	ECE55	Engineering Electromagnetics	3	0	1	0	4	5	0	50	50	100
6	ECE56X	Professional Elective – I	3	0	0	1	4	3	0	50	50	100
7	ECE57	Mini Project-III	0	2	0	0	2	0	0	25	25	50
		TOTAL					**28**	**21**	**12**	**400**	**400**	**800**

Third Year / Sixth Semester												
Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE61	Digital Communication	3	2	0	0	5	3	4	75	75	150
2	ECE62	Embedded System Design	3	2	0	0	5	3	4	75	75	150
3	ECE63	Microelectronic Circuits	4	0	0	0	4	4	0	50	50	100
4	ECE64	Microwaves and Radar	4	0	0	0	4	4	0	50	50	100
5	ECE65X	Professional Elective – II	3	0	0	1	4	3	0	50	50	100
6	NHOPXX	Open Elective – I	3	0	0	1	4	3	0	50	50	100
7	ECE67	Mini Project-IV	0	2	0	0	2	0	0	25	25	50
		TOTAL					**28**	**20**	**8**	**375**	**375**	**750**

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2017 -2021

Department of Electronics and Communication Engineering

Academic Year: 2019 – 2020

Syllabus of Fifth Semester

Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE51	Analog Communication	3	2	0	0	5	3	4	75	75	150
2	ECE52	Microcontrollers	3	2	0	0	5	3	4	75	75	150
3	ECE53	CMOS VLSI Design	3	2	0	0	5	3	4	75	75	150
4	ECE54	Information Theory and Coding	3	0	0	0	3	3	0	50	50	100
5	ECE55	Engineering Electromagnetics	3	0	1	0	4	5	0	50	50	100
6	ECE56X	Professional Elective – I	3	0	0	1	4	3	0	50	50	100
7	ECE57	Mini Project-III	0	2	0	0	2	0	0	25	25	50
		TOTAL					**28**	**21**	**12**	**400**	**400**	**800**

Professional Elective – I (GROUP 1)

ECE561: Real time systems
ECE562: Semiconductor Device and Physics
ECE563: Optical Fiber Communication
ECE564: DSP algorithms and architecture
ECE565: Operating Systems
ECE566: Programming with data structures

ANALOG COMMUNICATION			
Course Code	**: ECE51**	**Credits**	**:05**
L: P: T: S	**: 3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**: 3+3**	**SEE Marks**	**:50+25**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Compare the Generation and Detection of Analog modulation techniques
CO2	Apply the knowledge of Fourier transform and its properties for Analog modulation techniques.
CO3	Apply the concept of Hilbert transform to express the complex envelope of band pass signals
CO4	Evaluate the Power consumption and Bandwidth utilization in Analog modulation techniques.
CO5	Illustrate the random process and develop applications for societal benefits with minImial noise effects.
CO6	Conduct experiments to demonstrate the concepts of Analog communication and its applications

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	AMPLITUDE MODULATION: Introduction, Time domain description of AM wave, Frequency domain description of AM wave, Generation of AM wave- Square law modulator. Detection of AM wave-Envelope detector.Double side band suppressed carrier modulation (DSB-SC): Time domain description of DSB-SC wave, Frequency domain description of DSB-SC wave, Generation of DSB-SC wave- Balanced modulator, Detection ofDSB-SC wave - Costas Receiver, Quadrature carrier multiplexing.	9	CO1 CO2 CO4 CO6
	List of Experiments 1. Amplitude modulation using BJT/FET (Generation and Detection) - Hardwired as well as SPICE coding 2. PWM and PPM 3. Pulse amplitude modulation and detection	6	
2	SINGLE SIDE-BAND MODULATION (SSB): Hilbert transform, Properties of Hilbert transform, Pre-envelope, Canonical representation of band pass signals, Frequency domain description of SSB wave, Time domain Description of SSB wave, Phase discrimination method for generating an SSB wave, Demodulation of SSB wave	9	CO1 CO3 CO4 CO6

	List of Experiments 1. Second order active filters (LPF,HPF,BPF,BEF) – Hardwired as well as SPICE coding 2. Design and test a Schmitt Trigger circuit for the given values of UTP and LTP	6	
3	VESTIGIAL SIDE-BAND MODULATION (VSB): Frequency domain description, Time domain description, Generation of VSB modulated wave, Envelope detection of VSB wave plus carrier, Comparison of modulation techniques, Frequency translation, Frequency Division Multiplexing, Radio receivers- Receiver types, AM receivers.(Ref book 1 for Radio receivers)	9	CO1 CO3 CO4 CO6
	List of Experiments 1. IF amplifier design 2. Astable and Monostable multivibrator circuits using 555 timer	6	
4	ANGLE MODULATION: Basic definitions for FM and PM, Narrow band FM, Wide band FM, Transmission bandwidth of FM waves, Generation of FM wave- Indirect FM and Direct FM, Demodulation of FM wave- Frequency Discriminator, Zero crossing detector, Linear and Non Linear model of the Phase Locked Loop.	9	CO1 CO2 CO4 CO6
	List of Experiments 1. Frequency modulation - using 8038/2206 as well as SPICE coding 2. Frequency synthesis using PLL	6	
5	RANDOM PROCESSES: Introduction, Mathematical Definition of Random process, Mean, Correlation and Covariance Functions, Power Spectral Density, Gaussian Process.NOISE: Introduction, Types of Noise, Noise equivalent bandwidth, Noise Figure, Equivalent Noise temperature, Cascade connection of Two-port networks, Noise in CW Modulation Systems: Noise in DSB-SC Receivers, Noise in AM Receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM	9	CO5 CO6
	List of Experiments • Design and test R-2R DAC using op-amp • Precision rectifiers – both Full Wave and Half wave	6	

Text Books:

1. Communication Systems, Simon Haykin, 5th Edition, 2013, John Willey India Pvt. Ltd.
2. An Introduction to Analog and Digital Communication, Simon Haykin, 2008, John Wiley India Pvt. Ltd.

Reference books:

1.Electronic communication systems, Kennedy and Davis, 5th edition, 2011, TMH.
2.Modern digital and analog Communication systems, B. P. Lathi, 3rd edition, 2015, Oxford University Press.
3.Communication Systems - Analog and digital, Singh and Sapre, 2nd edition, 2007, TMH.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-curricular Activities
Marks	**25**	**10**	**5**	**10**
Remember	10	-	-	-
Understand	10	-	-	-
Apply	5	5	-	5
Analyze	5	-	5	-
Evaluate	5	5	-	5
Create	-	-	-	-

Practical (25 Marks)

Bloom's Taxonomy	Tests	Quizzes
Marks	**20**	**5**
Remember	5	-
Understand	10	5
Apply	5	-
Analyze	-	-
Evaluate	-	-
Create	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	20
Understand	10
Apply	10
Analyze	10
Evaluate	-
Create	-

Practical (25 Marks)

Bloom's Taxonomy	Tests
Marks	**25**
Remember	10
Understand	5
Apply	10
Analyze	-
Evaluate	-
Create	-

MICROCONTROLLERS			
Course Code	**: ECE52**	**Credits**	**:05**
L: P: T: S	**: 3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**: 3+3**	**SEE Marks**	**:50+25**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Describe the architectural features of 8086 Microprocessor
CO2	Describe the architecture of 8051 Microcontroller and to aspire design aspects of I/O and Memory interfacing circuits
CO3	Apply the basic knowledge of addressing modes to write assembly language program in 8051 Microcontroller
CO4	Analyze the code in assembly level for application of 8051 Timers, Interrupts and Serial Communication interface
CO5	Use modern tools and engage in self learning to carry out real world projects
CO6	Design an 8051 system by interfacing to external memory and I/O Peripherals

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	Introduction: Digital Computer, Microprocessors, Microcontrollers for embedded Systems8086 Microprocessor : 8086 CPU architecture, General Purpose Registers, Segment registers, PSW, Addressing modes, Instruction set summary ,Assembly language programming pin diagram in minimum mode	9	CO1 CO5
	List of Experiments 1. 8086 programs using MASM 2. Basic arithmetic and Logical operations 3. Code conversion and string operations	6	
2	8051 Microcontroller: Architecture, Working Registers, Special Function Registers(SFRs), I/O ports functions, Memory organization, External Memory (ROM & RAM) interfacing, Addressing Modes	9	CO2 CO5
	List of Experiments 1. Programming using data transfer instructions (block transfer, exchange sorting) in microprocessor	6	
3	8051 instructions: Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Stack and Subroutine instructions, Bit manipulation instruction., Assembler directives, Assembly language program examples	9	CO3 CO5

	List of Experiments 1. Programming using arithmetic instructions of 8051(16 bit) 2. Logical and Bit manipulations instructions. 3. Code conversion: BCD – ASCII; ASCII – Decimal; Decimal - ASCII; HEX - Decimal and Decimal - HEX .	6	
4	8051 Timers and Counters – Operation and Assembly language programming 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Assembly language programming for 8051 serial data transmission and reception, 8051 Interrupts and 8051 Assembly language Interrupts programming	9	CO4 CO5
	List of Experiments 1. Programming and verifying Timer, Interrupts and UART operations in 8051 microcontroller	6	
5	8051 Interfacing and Applications: Interfacing 8051 to simple switches and LEDs, LCD, ADC-0804 and Stepper motor and 8051 Assembly language Interfacing programming.	9	CO5 CO6
	List of Experiments(Assembly level programming) 1. Interfacing ADC and 8051 based temperature measurement 2. Interfacing – LED and LCD 3. Interfacing – stepper motor traffic light control	6	

Text Books:

1. The 8051 Microcontroller and Embedded Systems – using assembly and C , Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, 2nd Edition, 2006, Pearson.
2. Microcomputer Systems - The 8086/8088 Family Architecture, Programming and Design, Yu-cheng Liu and Glenn A. Gibson, 2nd Edition, 2015, Pearson.

Reference books:

1. Microprocessors and Interfacing – Programming & Hardware Douglas Hall, 2nd edition, 1990, McGraw Hill.
2. The 8051 Microcontroller Architecture, Programming & Applications, Kenneth J. Ayala, 2nd edition, 2007, Pearson education.
3. Microprocessors and Microcontrollers: Architecture, Programming and System Design, Krishna Kant, 2007, PHI.
4. The Intel Microprocessors Architecture, Programming and Interfacing, Barry B. Brey, 2007, Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-curricular Activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	-	-	-
Apply	5	5	5	5
Analyze	10	-	-	-
Evaluate	-	-	-	5
Create	-	5	-	-

Practical (25 Marks)

Bloom's Taxonomy	Tests	Quizzes
Marks	**20**	**5**
Remember	5	-
Understand	10	5
Apply	5	-
Analyze	-	-
Evaluate	-	-
Create	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	20
Understand	10
Apply	10
Analyze	10
Evaluate	-
Create	-

Practical (25 Marks)

Bloom's Taxonomy	Tests
Marks	**25**
Remember	10
Understand	5
Apply	10
Analyze	-
Evaluate	-
Create	-

CMOS VLSI Design			
Course Code	**: ECE53**	**Credits**	**:05**
L: P: T: S	**: 3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**: 3+3**	**SEE Marks**	**:50+25**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Illustrate the basic concepts of MOS Transistors.
CO2	Identify the current trends' in architectures of CMOS VLSI design.
CO3	Examine the process sequence of IC manufacturing technology
CO4	Make use of CMOS layout design rules for realization of digital circuit layouts
CO5	Evaluate the performance issues in the Analog Design.
CO6	Distinguish the faults occuring in Combinational and Sequential circuits of digital systems

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	INTRODUCTIN: Historical Perspective, Introduction to IC Technology, Types of ICs, VLSI Design Methodology, Design Domains - Y chart, Hierarchical Abstraction, VLSI Design Steps, VLSI Design Styles, Computer-aided Design, IC Chip Industry – A Brief Outlook, Recent Developments and Future Projections. MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, VLSI Design Flow, Fabrication, Packaging, and Testing, Exercises on Stick diagrams using Euler path.	9	CO1 CO2
	List of Experiments 1. Draw the schematic of i) CMOS Inverter, ii) Transmission gate, for the given specifications, and verify using Transient and DC Analyses. 2. Draw the schematic of i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate for the given specifications, and verify using Transient and DC Analyses.	6	
2	MOS TRANSISTOR THEORY: Introduction, Ideal I-V characteristics, Non ideal I-V effects, DC transfer characteristics, Switch-level RC delay models.CMOS Processing Technology: CMOS Technologies, Layout Design Rules, CMOS Process Enhancements.	9	CO3 CO4

	List of Experiments 1. Draw the layout of i) CMOS Inverter, ii) Transmission gate, and perform physical verification using DRC, ERC and LVS. Extract RC and back annotate the same and verify the Design. 2. Draw the layout of i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate, and perform physical verification using DRC, ERC and LVS. Extract RC and back annotate the same and verify the Design.	6	
3	Digital CMOS LOGIC DESIGN: Classification of CMOS Digital Logic Circuit, Combinational Logic Circuit, Sequential Logic Circuit, Pseudo-nMOS Logic, CMOS Transmission Gate, Dynamic and Domino CMOS Logic, NORA and Zipper CMOS Logic, TSPC Dynamic CMOS Logic, PTL and CPTL, Voltage Bootstrapping, Differential CMOS Logic, Adiabatic Logic, DTCMOS Logic.Semiconductor Memories, BiCMOS Technology and Circuits.	9	CO2
	List of Experiments 1. For the following circuits, write the switch level Verilog Code, and verify using Test Bench: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates 2. For the following circuits, write the switch level Verilog Code and verify using Test Bench: i) 2-input EXOR gate using CMOS logic, ii) 2-input EXOR gate using PTL 3. Synthesize the following circuits using the gate level Verilog Code, with the given Constraints: i) CMOS inverter, ii) 2-input CMOS NAND and NOR gates	6	
4	**TIMING ANALYSIS:** Delay in general, Slew Balancing & Transistor Equivalency, Design of 2-Inputs NAND & NOR Gates for Equal Rise and Fall Slew, MOS Capacitances, Design Techniques for Delay Reduction, Intrinsic Delay of Inverter and its Sizing Effect on Propagation Delay, Inverter Chain Design, Logical Effort, Timing Analysis & Models & Goals, Static vs Dynamic Timing Verification, Factors Impacting Timing Delay, Static Timing Analysis - Case Study, Fixed Delay Model & Timing Constraints, Timing Verification in Sequential Synchronous Circuits, Issues with Static Delay Modeling, First-order Gate Delay Model & Parasitic Extraction, Timing Convergence Problem, Timing-Driven Logic and Layout Synthesis.	9	CO5
	List of Experiments For the following circuits, write the Verilog Code, verify using Test Bench, and then synthesize with the given Constraints:i) 4-bit Parallel adder, ii) D Flip-flop, iii) T Flip-flop,iv) 4-bit Synchronous counter	6	
5	TESTING AND VERIFICATION: Introduction, Testers, Test Fixture and Test Programs, Logic Verification Principles, Silicon Debug Principles, Manufacturing Test Principles, Design for Testability, Boundary Scan, Testing in a University Environment.	9	CO6
	List of Experiments 1. Draw the schematic of i) Common source, ii) Common Drain amplifier, for the given specifications, and verify using Transient, DC and AC Analyses. 2. Draw the layout of i) Common source, ii) Common Drain amplifier, and perform physical verification using DRC, ERC and LVS. Extract RC and back annotate the same and verify the Design. 3. Draw the schematic of i) Differential Amplifier, ii) Op- amp, for the given specifications, and verify using Transient, DC and AC Analyses. 4. Draw the layout of i) Differential Amplifier, ii) Op-amp, and perform	6	

	physical verification using DRC, ERC and LVS. Extract RC and back annotate the same and verify the Design.		

Text Books:

1. CMOS VLSI Design – A Circuits and Systems Perspective, N.H. Weste, David Harris, Ayan Banerjee, 3rd Edition, 2010, Pearson Education.
2. VLSI Design, Debaprasad Das, 2nd edition, 2016, Oxford University Press

Reference books:

1. MOS VLSI Design – A Circuits and Systems Perspective, N.H. Weste and David Harris, 4th Edition, 2014, Pearson Education (http://www.cmosvlsi.com)
2. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2007, TMH.
3. Digital Integrated Circuits – A design Perspective, Jan M. Rabaey, AnanthaChandrakasan, Borivoje Nikolic, 2nd Edition, 2009, Prentice-Hall.
4. Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2011, PHI.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-curricular Activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	5	-	-
Apply	10	5	-	5
Analyze	5	-	5	-
Evaluate	-	-	-	5
Create	-	-	-	-

Practical (25 Marks)

Bloom's Taxonomy	Tests	Quizzes
Marks	**20**	**5**
Remember	5	-
Understand	5	5
Apply	10	-
Analyze	-	-
Evaluate	-	-
Create	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

Practical (25 Marks)

Bloom's Taxonomy	Tests
Marks	**25**
Remember	10
Understand	5
Apply	10
Analyze	-
Evaluate	-
Create	-

INFORMATION THEORY AND CODING			
Course Code	**: ECE54**	**Credits**	**:03**
L: P: T: S	**: 3:0:0:0**	**CIE Marks**	**:50**
Exam Hours	**: 3**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Identify the importance of Information and coding techniques essential for communication system
CO2	Analyze various Information sources and channel capacities
CO3	Illustrate the significance of source coding and channel coding techniques for digital communication systems
CO4	Realize the coding and decoding techniques for digital communication design
CO5	Estimate the error detection and correction capabilities of channel codes for error free communication
CO6	Examine various statistical approaches for signal detection

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	Information Theory Introduction, Uncertainty, Information and its property, Entropy and its property, Joint and Conditional Entropy, Mutual Information andits property, Information measures for Continuous random variables.	9	CO1 CO2
2	Channel classification and Capacity: Channel capacity theorem, Continuous and Discrete Communication channels – Discrete memory less channels - channel representations - noiseless channel, lossless channels, Deterministic, Binarysymmetric channel (BSC), Binary Erasure channel (BEC) and their capacities.	9	CO1 CO2 CO3
3	Source Coding Techniques: Coding for Discrete memory less sources: – Fixed length code words, Variable length code words, Kraft Inequality, Prefix coding, Shannon‟s first , second and third theorem, Shannon binary Encoding, Shannon-Fano Encoding, Huffman Coding : minimum and maximum variance method, Arithmetic Coding, Dictionary Coding- LZ , LZW Coding	9	CO3 CO4 CO5
4	Error Control Coding: Types of Errors, Types of Codes, Linear Block Codes: Error Detection and Error Correction Capabilities of Linear Block codes, Binary Cyclic codes , Encoding using Shift register, Syndrome Calculation, Error detection, and Error correction, Convolutional codes – Encoders and Decoders for convolutional codes, LDPC Codes, Trellis Codes, Turbo Codes, Viterbi Coding.	9	CO3 CO4 CO5

5	Detection of Signals and Channels with Noise : Hypothesis testing – Baye's criterion – Minimum error probability criterion, Neyman Pearson criterion, Minma criterion-Maximum Likelihood detector-Wiener filter-Continuous and Discrete channels with noise.	9	CO1 CO5 CO6

Text Books:

1. Digital and analog communication systems, K. Sam Shanmugam, 2006, John Wiley.
2. Communication Systems, Simon Haykin, 2009, John Wiley and Sons.

Reference books:

1. Information Theory, Coding and Cryptography, Ranjan Bose, 2012, Tata McGraw Hill.
2. Elements of Information Theory, Thomas M. Cover and Joy A. Thomas, 2004, John Wiley and Sons.
3. Digital Communications: Fundamentals & Applications, Bernard Sklar, 2nd edition, 2009.
4. Digital Communication, Meinel C. and Sack H., 2014, Springer publications.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular Activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	5	-	-
Apply	10	5	-	5
Analyze	5	-	5	-
Evaluate	-	-	-	5
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	-
Create	-

ENGINEERING ELECTROMAGNETICS			
Course Code	**: ECE55**	**Credits**	**:04**
L: P: T: S	**: 3:0:1:0**	**CIE Marks**	**:50**
Exam Hours	**: 3**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Apply vector concepts for laws and theorem in electromagnetics fields
CO2	Apply the static characteristics of electromagnetic fields to different charge and current distribution
CO3	Analyze the boundary characteristics of electromagnetic fields on different media
CO4	Illustrate the concept of capacitance and inductance using electromagnetic fields
CO5	Categorize the Maxwell's Equations for static and time varying electromagnetic fields
CO6	Analyze the characteristics of electromagnetic waves over different media

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**FUNDUMENTALS OF ELECTROSTATICS:** Vector analysis**,** Experimental law of Coulomb, Electric field intensity, Electric flux density, Gauss' law, Maxwell's First equation(Electrostatics), divergence theorem, Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge, Potential gradient.	9	CO1 CO2
2	**PROPERTIES OF ELECTROSTATICS AND BOUNDARY CONDITIONS :** Current and current density, Conductor properties and boundary conditions, boundary conditions for perfect Dielectrics, Derivations of Poisson's and Laplace's Equations, Examples of the solutions of Laplace's and Poisson's equations.	9	CO2 CO3 CO4
3	**INTRODUCTION TO MAGNETOSTATICS:** Biot-Savart law, Ampere's circuital law, Curl, Stokes' theorem, magnetic flux and flux density, scalar and Vector magnetic potentials.	9	CO1 CO2
4	**TIME VARYING FIELDS AND MAXWELL'S EQUATIONS:** Magnetic circuit, Inductance and Mutual Inductance, Faraday's law, displacement current, Maxwell's equation in point and Integral form.	9	CO4 CO5

5	**UNIFORM PLANE WAVES AND THEIR PROPERTIES AT BOUNDARIES:** Wave propagation in free space and dielectrics, Poynting's theorem and wave power, propagation in good conductors – (skin effect), Reflection of uniform plane waves at normal incidence, SWR.	9	CO6

Text Book:

1. Engineering Electromagnetics, William H Hayt Jr. and John A Buck, 8th edition, 2014, Tata McGraw-Hill.

Reference books:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, 5th edition, 1999, McGraw-Hill.
2. Electromagnetic Waves And Radiating Systems, Edward C. Jordan and Keith G Balmain, 2nd edition, 2002, Prentice – Hall of India / Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular Activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	10	5	-	-
Apply	5	5	-	5
Analyze	5	-	5	-
Evaluate	-	-	-	5
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

REAL TIME SYSTEMS			
Course Code	**: ECE561**	**Credits**	**:04**
L: P: T: S	**: 3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**: 03**	**SEE Marks**	**:50**

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

CO1	Understand the real-time system and its functions
CO2	Apply formal methods for scheduling real-time systems
CO3	Analyze the design patterns and program structures of RTS
CO4	Appraise the choice of database requirements and communication methods for RTS
CO5	Investigate the fault tolerance issues and approaches
CO6	Design and implement a real-time systems

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	INTRODUCTION Introduction - Issues in Real Time Computing, Structure of a Real Time System. Task Classes, Performance Measures for Real Time Systems, Estimating Program Run times. Case study on practical applications of real time systems.	9	CO1
2	Task Assignment and Scheduling - Classical Uniprocessor scheduling algorithms, UniProcessor scheduling of IRIS Tasks, Task Assignment, Mode Changes, and Fault Tolerant Scheduling.	9	CO1, CO2, CO3
3	PROGRAMMING LANGUAGES AND TOOLS Programming Language and Tools – Desired Language characteristics, Data Typing, Control structures, Facilitating Hierarchical Decomposition, Packages, Run-time (Exception) Error handling, Overloading and Generics, Multitasking, Low Level programming, Task scheduling, Timing Specifications, Programming Environments, Run-time Support.	9	CO4, CO5
4	REAL TIME DATABASES Real time Databases - Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities,	9	CO4

	Transaction Aborts, Concurrency Control Issues, Disk Scheduling Algorithms, Two-phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time systems.		
5	COMMUNICATION Real-Time Communication - Communications Media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques - Fault Types, Fault Detection. Fault Error Containment Redundancy, Data Diversity, Reversal Checks, Integrated Failure handling.	9	CO5, CO6

Text Books:

1. Real-Time Systems, C.M. Krishna, Kang G. Shin, 2010, Tata McGraw-Hill Edition.

Reference books:

1. Scheduling Algorithms for Real-Time Systems, Jim Ras, 2016, Lulu Press.
2. Real Time Computer Control-An Introduction, Stuart Bennett, 3rd edition, 2009, Pearson Education Ltd.
3. Real-Time Systems Design and Analysis, Philip A. Laplante, 3rdEdition,2004, Wiley.
4. Real-Time Systems, Jane W. S. Liu, 8th edition, 2009, Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation (50Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	20	10	10	10
Remember	5	-	-	-
Understand	5	-	5	-
Apply	5	5	-	-
Analyze	5	5	-	5
Evaluate	-	-	5	5
Create	-	-	-	-

SEE- Semester End Examination (50Marks)

Bloom's Category	Tests
Remember	5
Understand	10
Apply	10
Analyze	15
Evaluate	10
Create	-

SEMICONDUCTOR DEVICE PHYSICS			
Course Code	**: ECE562**	**Credits**	**:05**
L:T: P	**:3:0:0**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will be able:

CO1	Understand the principles and fundamentals of semiconductor, along with the crystal structures of semiconductor devices.
CO2	Describe the principles of atomic structure and its formulation by using the basics of Quantum mechanics.
CO3	Discuss the fabrication process of PN junction diode and its qualitative analysis.
CO4	Illustrate the formulation of BJT operation, and the different current mechanisms in transistors.
CO5	Distinguish between the different models for the transistors at low and high frequencies.
CO6	Examine the MOSFET operations, characteristics and second order effects of MOSFET.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	CRYSTAL PROPERTIES AND GROWTHOF SEMICONDUCTORS: Semiconductor Materials Crystal Lattices Periodic StructuresCubic Lattices Planes and Directions The Diamond Lattice 10Bulk Crystal Growth Starting Materials Growth of Single-Crystal Ingots Wafers Doping Epitaxial Growth Lattice-Matching in Epitaxial Growth Vapor-Phase Epitaxy Molecular Beam Epitaxy ATOMS AND ELECTRONS :Introduction to Physical Models Experimental Observations The Photoelectric Effect Atomic Spectra The Bohr Model Quantum Mechanics Probability and the Uncertainty Principle The Schrodinger Wave Equation Potential Well Problem Tunneling Atomic Structure and the Periodic Table The Hydrogen Atom The Periodic Table	9	CO1, CO2

2	ENERGY BANDS AND CHARGE CARRIERS IN SEMICONDUCTORS: Bonding Forces and Energy Bands in Solids Bonding Forces in Solids Energy Bands Metals, Semiconductors, and Insulators Direct and Indirect Semiconductors. Variation of Energy Bands with Alloy Composition Charge Carriers in Semiconductors: Electrons and Holes Effective Mass Intrinsic Material Extrinsic Material Electrons and Holes in Quantum Wells Carrier. Concentrations: The Fermi Level Electron and Hole Concentrations at Equilibrium Temperature Dependence of Carrier Concentrations Compensation and Space Charge Neutrality. Drift of Carriers in Electric and Magnetic Fields: Conductivity and Mobility Drift and Resistance effects of Temperature and Doping on Mobility High-Field Effects The Hall Effect. Invariance of the Fermi Level at Equilibrium	9	CO3
3	JUNCTIONS: Fabrication of p-n Junctions: Thermal Oxidation Diffusion. Rapid Thermal Processing. Ion Implantation. Chemical Vapor Deposition (CVD).Photolithography. Etching. Metallization. Equilibrium Conditions: The Contact Potential. Equilibrium Fermi Levels. Space Charge at a Junction. Forward- and Reverse-Biased Junctions; Steady State Conditions: Qualitative Description of Current Flow at a Junction. Carrier Injection. Reverse Bias Reverse-Bias Breakdown: Zener Breakdown. Avalanche Breakdown. Rectifiers. The Breakdown Diode. Transient and A-C Conditions: Time Variation of Stored Charge. Reverse Recovery Transient. Switching Diodes. Capacitance of p-n junctions. The Varactor Diode. Deviations from the Simple Theory: Effects of Contact Potential on Carrier Injection. Recombination and Generation in the Transition Region. Ohmic Losses. Graded Junctions. Metal-Semiconductor Junctions: Schottky Barriers. Rectifying Contacts Ohmic Contact. Typical Schottky Barriers. Heterojunctions	9	CO4
4	BIPOLAR JUNCTION TRANSISTORS: Fundamentals of BJT Operation. Amplification with BJTs. BJT Fabrication Minority Carrier Distributions and Terminal Currents: Solution of the Diffusion Equation in the Base Region Evaluation of the Terminal Currents. Approximations of the Terminal Currents. Current Transfer Ratio. Generalized Biasing: The Coupled-Diode Model. Charge Control Analysis. Switching: Cutoff Saturation. The Switching Cycle. Specifications for Switching Transistors Other Important Effects: Drift in the Base Region. Base Narrowing Avalanche Breakdown. Injection Level; Thermal Effects. Base Resistance and Emitter Crowding. Gummel-Poon Model. Kirk Effect. Frequency Limitations of Transistors: Capacitance and Charging Times Transit Time Effects. Webster Effect. High-Frequency Transistors. Hetero junctions Bipolar Transistors.	9	CO5
5	FIELD-EFFECTTRANSISTORS: Transistor Operation The Load Line. Amplification and Switching. The Junction FET. Pinch-off and Saturation. Gate Control. Current-Voltage Characteristics The Metal-Semiconductor FET. The GaAs MESFET. The High Electron Mobility Transistor (HEMT). Short Channel Effects. The Metal-insulator-Semiconductor FET. Basic Operation and Fabrication The Ideal MOS Capacitor. Effects of Real Surfaces. Threshold Voltage MOS Capacitance-Voltage Analysis. Time-	9	CO6

	Dependent Capacitance Measurements. Current-Voltage Characteristics of MOS Gate Oxides. The MOS Field-Effect Transistor. Output Characteristics Transfer Characteristics. Mobility Models. Short Channel MOSFET l-V Characteristics. Control of Threshold Voltage. Substrate Bias Effects. Sub threshold Characteristics. Equivalent Circuit for the MOSFET. MOSFET Scaling and Hot Electron Effects. Drain-Induced Barrier Lowering Short Channel Effect and Narrow Width Effect. Gate-Induced Drain Leakage.		

TEXT BOOKS:

1. Solid State Electronic Devices. Ben G. Streetman and Sanjay Kumar Banerjee. Sixth edition. PHI Private Learning Limited. New Delhi 2009

REFERENCE BOOKS:

1. Advanced Semiconductors Fundamentals. Second Edition. Robert Pierret. Modular Series on Solid State Devices. Semiconductor Physics and Devices Basic Principles. Donald A Neamen. Third Edition. TMH Publications
2. Introduction to Solid State Physics. Charles Kittel. Seventh Edition.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	5	-	5
Understand	10	-	5
Apply	5	7.5	-
Analyze	5	7.5	-
Evaluate	-	-	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	Tests
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

OPTICAL FIBER COMMUNICATION			
Course Code	**: ECE563**	**Credits**	**:04**
L: P: T: S	**: 3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**: 3**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Describe the basic fundamentals of optical fiber communication
CO2	Construct the structures of Optical fiber and types
CO3	Examine the contribution of channel impairments like attenuation and dispersion in optical signal transmission
CO4	Categorize the Optical sources and detectors based on their performance
CO5	Evaluate the link power budget for design of fiber optic systems
CO6	Analyze the principle of WDM highlighting its applications in optical networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**OVERVIEW OF OPTICAL FIBER COMMUNICATION:** Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory, cylindrical fiber (no derivations in article 2.4.4), single mode fiber, cutoff wave length and mode filed diameter. Optical sources: LED's,, LASER diodes,	09	CO1 CO2
2	**TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS:** Introduction, Attenuation, absorption, scattering losses, bending loss, dispersion Intra model dispersion, Inter model dispersion.	09	CO3
3	**OPTICAL RECEIVER:** Introduction, Photo detectors: PIN and APD, Photo detector noise. Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection, Optical amplifiers, basic applications and types, Semiconductor optical amplifiers, EDFA.	09	CO4
4	**ANALOG AND DIGITAL LINKS:** Analog links – Introduction, overview of analog links, CNR, multichannel transmission techniques, RF over fiber, key link parameters, Radio over fiber links, microwave photonics.Digital links – Introduction, point–to–point links,	09	CO5

	System considerations, linkpower budget, resistive budget, short wave length band, transmission distance for single mode fibers, Power penalties, nodal noise and chirping.		
5	**WDM CONCEPTS AND COMPONENTS:** WDM concepts, overview of WDM operation principles, WDM standards, Mach-Zehender interferometer, multiplexer, couplers, Isolators and circulators, direct thin film filters, active optical components, MEMS technology, variable optical attenuators, tunable optical fibers, dynamic gain equalizers, optical drop multiplexers, polarization controllers, chromatic dispersion compensators, tunable light sources.	09	CO6

Text Books:

1. Optical Fiber Communication, Gerd Keiser, 4th Ed., MGH,2008.
2. Optical Fiber Communications, John M. Senior, PearsonEducation. 3rd Impression, 2007.

Reference books:

1. Fiber Optic Communication - Joseph C Palais: 4th Edition, Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	10	-	5	-
Understand	10	5	-	-
Apply	-	5	-	5
Analyze	-	-	5	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	15
Understand	15
Apply	15
Analyze	5
Evaluate	-
Create	-

DSP ALGORITHMS AND ARCHITECTURE			
Course Code	**: ECE564**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Understand the basic features used in digital signal processing system.
CO2	Analyze the architectures of digital signal processors.
CO3	Illustrate the concepts of pipeline operations and memory interfacing.
CO4	Apply the assembly level implementation of DSP algorithms.
CO5	Demonstrate the interfacing of memory with DSP processor.
CO6	Appraise the applications of DSP processor.

Mapping of Course Outcomes to Program Outcomes:

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

SYLLABUS			
Sl no	**Contents of Module**	**Hours**	**COs**
1	**Architectures for Programmable Digital Signal Processing Devices:** Introduction, Major features of Programmable DSP, sampling rate conversion methods, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Program sequencer.	**9**	**CO1, CO2**
2	**Programmable Digital Signal Processors:** Introduction, Commercial DSP devices, Data addressing modes of TMS320C54xx Digital Signal Processors, memory space of TMS320C54xx processors, program control, TMS320C54xx instructions and programming, pipeling operation of TMS320C54xx processors.	**9**	**CO2, CO3**
3	**Implementation of basic DSP Algorithms**: Introduction, number formats for signals and filter coefficient, Q-notation, FIR Filters, IIR	**9**	**CO4**

	Filters, Decimation and Interpolation filters, Adaptive filters.		
4	**Implementation of FFT Algorithms:** Introduction, an FFT algorithm for DFT computation, a butterfly computation, overflow and scaling, bit-reversed index generation, an 8-point FFT implementation on the TMS320C54xx processor, computation of the signal spectrum.	**9**	**CO4**
5	**Interfacing Memory and I/O Peripherals and Application of Programmable DSP Devices:** Introduction, External Bus Interfacing Signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, DMA, A CODEC interface circuit. **Application:** DSP based Biotelemetry receiver, Encoding and decoding of JPEG using the TMS320C54XX.	**9**	**CO5** **CO6**

TEXT BOOKS:

1. "Digital Signal Processing", Avatar Singh and S. Srinivasan, Cengage Learning Private Limited, 2004.

REFERENCE BOOKS:

1. "Digital Signal Processing: A practical approach," Ifeachor E. C., Jervis B. W., Pearson-Education, PHI/2002.
2. "Digital Signal Processors", B Venkataramani and M Bhaskar, TMH, 2nd Edition, 2010.
3. "Architectures for Digital Signal Processing", Peter Pirsch, Wiley India Private Limited, 2008.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**	**Self Study**
Marks (out of 50)	20	10	10	10
Remember	10	-	5	-
Understand	10	5	-	5
Apply	10	5	-	-
Analyze	-	-	5	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Category	**Tests**
Remember	10
Understand	20
Apply	20
Analyze	-
Evaluate	-
Create	-

OPERATING SYSTEMS			
Course Code	**:ECE565**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Describe the basic concepts and functions of operating systems.
CO2	Explain about Processes, Threads, Scheduling algorithms, Message Passing between processes, and process synchronization.
CO3	Apply various Memory Management techniques and Virtual Memory concepts.
CO4	Build File Systems and I/O Management.
CO5	Apply the protection methods to the various Security issues involving computers and OS.
CO6	Analyze different OSs after doing Case Studies.

Mapping of Course Outcomes to Program Outcomes:

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

SYLLABUS			
Sl no.	Contents of Module	Hours	COs
1	OVERVIEW AND STRUCTURE OF OPERATING SYSTEMS: Operating system, Goals of an O.S, Operation of an O.S, Resource allocation and related functions, Classes of operating systems, Batch processing system, Multiprogramming systems, Time sharing systems, Real time operating systems, Distributed operating systems. Structure of an operating system, Operating system with monolithic structure, Layered design, Virtual machine operating systems, Kernel based operating systems, and Microkernel based operating systems, Architecture of Unix, Architecture of Windows.	9	CO1, CO6

2	PROCESS MANAGEMENT: Process concept, Programmer view ofprocesses, OS view of processes, Interacting processes, Implementing message passing, Mailboxes, Inter process communication in UNIX Threads, Processes in UNIX, Threads in Solaris. Fundamentals of scheduling, Long-term scheduling, Medium and short term scheduling, Real time scheduling, Process scheduling in UNIX, Deadlocks, Multithread and Multicore programming, Multiprocessor scheduling, Process synchronization, Concurrency, Critical Section problem, Mutex locks, Semaphores, Monitors.	9	CO2, CO6
3	MEMORY MANAGEMENT: Memory allocation to programs, Memory allocation preliminaries, Contiguous and noncontiguous allocation to programs, Memory allocation for program controlled data, kernel Memory allocation. Virtual memory basics, Virtual memory using paging, Demand paging, Page replacement, Page replacement policies, Memory allocation to programs, Page sharing, UNIX virtual memory, Virtual memory in Windows, Thrashing.	9	CO3, CO6
4	FILE SYSTEMS and I/O MANAGEMENT: File system and IOCS, Files and directories, Overview of I/O organization, Fundamental file organizations, Interface between file system and IOCS, Allocation of disk space, Implementing file access, UNIX file system, Mass Storage Structure - Overview, Disk structure, Disk attachment, Disk Scheduling and Management, Swap space Management, RAID Structure, Linux I/O.	9	CO4, CO6
5	PROTECTION and SECURITY: Protection - Goals of Protection, Principles of protection, Domain of protection, Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability-based systems, Language-based protection. Security - The Security problem, Program threats, System and Network threats, Cryptography as a security tool, User authentication, Implementing security defenses, Fire walling to protect systems and networks, Computer-security classifications, Case study of Windows XP.	9	CO5, CO6

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, and Greg Gagne, 9th Edition,2012, John Wiley.
2. Operating Systems- A Concept based Approach, D.M. Dhamdhere, 3rd Edition, 2012, Tata McGraw Hill.

Reference books:

1. Operating Systems - Internals and Design Principles, William Stallings, 8th Edition, 2014, PearsonEducation.
2. Modern Operating Systems, Andrew S Tanenbaum, 4th Edition, 2014, Pearson Education.
3. Design of the Unix Operating System - Maurice J Bach, 1st Edition, 1986, Prentice Hall.
4. Operating Systems - System Programming and Operating Systems, D M Dhamdhere, 2nd Edition, 1999, Tata Mc Graw Hill.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	20	10	10	10
Remember	10		5	
Understand	10	5		
Apply		5		5
Analyze			5	
Evaluate				5
Create				

SEE- Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

PROGRAMMING WITH DATA STRUCTURES			
Course Code	**:ECE566**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Develop programs using concepts of memory allocation, Pointers and Arrays .
CO2	Compare stacks and queues using dynamic arrays.
CO3	Build projects to investigate and resolve environmental problems using linked lists.
CO4	List the types of trees and their operations performed .
CO5	Analyze searching and sorting tree algorithms to solve complex engineering problems.
CO6	Engage for lifelong learning and work on multidisplinary projects to overcome societal problems.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**POINTERS AND ARRAYS:** Dynamic Memory Allocation, Algorithm Specification, Data Abstraction, Dynamically Allocated Arrays, Structures and Unions, Polynomials, Sparse Matrices, Representation of Multidimensional Arrays.	9	**CO1**
2	**STACKS AND QUEUES:** Stacks, Stacks Using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues.	9	**CO1 CO2**
3	**LINKED LISTS:** Singly Linked lists and Chains, Representing Chains in C, Linked Stacks and Queues, Polynomials, Additional List operations, Sparse Matrices, Doubly Linked Lists.	9	**CO3 CO6**
4	**TREES:** Introduction, Binary Trees, Binary Tree Traversals, Threaded Binary Trees, Heaps. Binary Search Trees, Selection Trees, Forests, Representation of Disjoint Sets, Counting Binary Trees.	9	**CO4 CO6**
5	**SEARCHING & SORTING: Sorting:** sort concepts-sort order, sort stability, sort efficiency, Types of sorting: Insertion sort, Quick Sort, Merge Sort, Heap sort. **Types of Searching:** Binary Search, Linear Search. Efficient Binary Search Trees: Optimal Binary Search Trees, AVL Trees.	9	**CO1 CO4 CO5 CO6**

Text Books:

1. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson-Freed, 2nd Edition, 2011, Universities Press.

Reference Books:

1. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg and Behrouz A. Forouzan, 2012, CengageLearning.

2. Data Structures using C, Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, 2nd Edition, 2013, PearsonEducation.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	10	-	5	-
Understand	10	5	-	-
Apply	-	5	-	5
Analyze	-	-	5	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	20
Apply	15
Analyze	5
Evaluate	-
Create	-

MINI PROJECT-III			
Course Code	**:ECE57**	**Credits**	**:02**
L: P: T: S	**:0:2:0:0**	**CIE Marks**	**:25**
Exam Hours	**:03**	**SEE Marks**	**:25**

The student will have the ability to

	Course outcomes
CO1	Identify technical aspects of the chosen project with a comprehensive and systematic approach
CO2	Review the literature and develop solutions for problem statement
CO3	Work as an individual or in a team in development of technical projects
CO4	Test the various phases of planned project
CO5	Articulate the project related activities and findings
CO6	Extend or use the idea in mini project for major project

Mapping of Course Outcomes to Program Outcomes:

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

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2017 -2021

Department of Electronics and Communication Engineering

Academic Year: 2019 – 2020

Syllabus of Sixth Semester

Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE61	Digital Communication	3	2	0	0	5	3	4	75	75	150
2	ECE62	Embedded System Design	3	2	0	0	5	3	4	75	75	150
3	ECE63	Microelectronic Circuits	4	0	0	0	4	4	0	50	50	100
4	ECE64	Microwaves and Radar	4	0	0	0	4	4	0	50	50	100
5	ECE65X	Professional Elective – II	3	0	0	1	4	3	0	50	50	100
6	NHOPXX	Open Elective – I	3	0	0	1	4	3	0	50	50	100
7	ECE67	Mini Project-IV	0	2	0	0	2	0	0	25	25	50
TOTAL							28	20	8	375	375	750

Professional Elective – II (GROUP 2)

ECE651: Real Time Operating Systems
ECE652:Analog and Mixed mode VLSI Design
ECE653: Computer communication Networks
ECE654: Object Oriented Programming
ECE655: Image Processing
ECE656: Digital Switching Systems

Open Elective – I

NHOP01: Big Data Analytics using HP Vertica - 1
NHOP02: VM Ware virtualization Essentials - 1
NHOP03: Adobe Experience manager - 1
NHOP07: SAP
NHOP08: Schneider - Industry Automation
NHOP09: Cisco - Routing & Switching – 1
NHOP10: Data Analytics
NHOP11: Machine Learning
NHOP13: Industrial IoT - Embedded Systems
NHOP14: Block chain
NHOP15: Product Life Cycle Management

DIGITAL COMMUNICATION			
Course Code	**:ECE61**	**Credits**	**:05**
L: P: T: S	**:3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**:03+03**	**SEE Marks**	**:50+25**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Apply the fundamentals of digital Communication for baseband signal processing and coding
CO2	Analyze the pulse shaping mechanism for distortion less base-band binary transmission
CO3	Categorize digital modulation techniques based on Bit Error Rate performance
CO4	Compare the access technologies available for multiuser communication in single-bandwidth
CO5	Estimate the signal in presence of noise by appropriate receiver design
CO6	Demonstrate the concepts of Digital communication and its applications

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Basic signal processing operations in digital communication:** Elements of a digital communication system, Sampling Theorem - Mathematical proof of sampling and reconstruction –ideal and Flat top sampling, Bandpass sampling ,quantization, Robust quantization-companding, Pulse code modulation, generation and detection of PCM, differential PCM; Delta modulation, Adaptive delta modulation, TDM-PCM, T1digital Hierarchy.	9	CO1 CO4
	LIST OF EXPERIMENTS: 1. TDM of two band limited signals. 2. PCM generation and detection using a CODEC Chip	6	
2	**Pulse Shaping for Data Transmission**: Discrete PAM signals, power spectra of discrete PAM signals, Derivation of power spectral density for NRZ unipolar format (other types expressions only),ISI, Nyquist's criterion for distortion less base-band binary transmission, eye pattern, Adaptive Equalization.	9	CO2 CO4

	LIST OF EXPERIMENTS: 1. Measurement of losses in a given optical fiber (propagation loss, bending loss) and numerical aperture. 2. Analog and Digital (with TDM) communication link using optical fiber.	6	
3	**Digital Modulation Techniques:** Digital Modulation formats, Coherent binary modulation techniques- Binary ASK, PSK, FSK, Coherent quadrature modulation techniques-QPSK, MSK. Non-coherent binary modulation techniques- DPSK , M-ary signaling schemes-M-ary PSK, M-ary QAM. Generation, detection, Signal space constellation, Performance, probability of bit error computation for all the modulation schemes, Comparison of Modulation techniques.	9	CO1 CO3 CO4
	LIST OF EXPERIMENTS: 1. ASK and FSK generation and detection 2. PSK generation and detection 3. DPSK generation and detection 4. QPSK generation and detection	6	
4	**Detection and estimation**: Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlator's to noisy input. Detection of known signals in noise, correlation receiver, matched filter receiver, detection of signals with unknown phase in noise.	9	CO1 CO4 CO5
	LIST OF EXPERIMENTS: 1. Measurement of frequency, guide wavelength, Power, VSWR and attenuation in a microwave test bench. 2. Measurement of directivity and gain of antennas: Standard dipole (or printed dipole), microstrip patch antenna and Yagi antenna (printed).	6	
5	**Spread Spectrum Techniques & Multiple Access Techniques:** Generation of PN Sequence and its properties – Direct Sequence Spread Spectrum – Processing Gain – Probability of Error – Anti jam Characteristics – Frequency Hopped Spread Spectrum – Slow and Fast frequency hopping–multiple access techniques TDMA, FDMA, CDMA	9	CO4 CO6
	LIST OF EXPERIMENTS: 1. Determination of coupling and isolation characteristics of a strip line (or micro strip) directional coupler. 2. Measurement of resonance characteristics of a microstrip ring resonator and determination of dielectric constant of the substrate. 3. Measurement of power division and isolation characteristics of a micro strip 3 dB power divider.	6	

Text Books:

1. Digital Communications, Simon Haykin, 2014, John Wiley.

2. Digital Communication, John G. Proakis, 5th Edition, 2014, Pearson Education.

Reference Books:

1. Digital Communications: Fundamentals and Applications, Bernard Sklar, 2016, Prentice Hall Publications.

2. Principles of Communication Systems, Herbert Taub and Donald L Schilling, 3rd Edition, 2012, Tata McGraw Hill.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	10	-	-	-
Apply	5	5	5	5
Analyze	5	5	-	-
Evaluate	-	-	-	5
Create	-	-	-	-

Practical (25 Marks)

Bloom's Taxonomy	Tests	Quizzes
Marks	**20**	**5**
Remember	5	-
Understand	5	5
Apply	10	-
Analyze	-	-
Evaluate	-	-
Create	-	-

Note: Numericals on PCM-TDM systems and probability of error computations relevant to various modulation schemes have to be given as an assignment during the semester, and has to be evaluated for 5 marks, under "Apply" category.

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	-

Practical (25 Marks)

Bloom's Taxonomy	Tests
Marks	**25**
Remember	5
Understand	10
Apply	10
Analyze	-
Evaluate	-
Create	-

EMBEDDED SYSTEM DESIGN			
Course Code	**:ECE62**	**Credits**	**:05**
L: P: T: S	**:3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**:03+03**	**SEE Marks**	**:50+25**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Choose system core, memory, communication and I/O interfaces to develop embedded applications
CO2	Identify the characteristics and quality attributes of embedded system
CO3	Appraise the architecture, programmers model and features of ARM Cortex M processor
CO4	Demonstrate experiments on developing embedded system
CO5	Analyze codes in assembly and high level for given applications using embedded software development suites
CO6	Select computational models in embedded design and engage in self learning by analyzing and carrying out embedded projects

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction to Embedded Systems:** What is an Embedded System, Embedded Systems Vs General Computing Systems, Classification of Embedded System, Major Application areas of Embedded System, Purpose of Embedded System, The Innovative Bonding of lifestyle with Embedded Technology.	9	CO1 CO5
	LIST OF EXPERIMENTS: 1.Study of ARM- Cortex M4 processor development board. 2.Write Assembly language programs involving Memory accessing instructions.	6	
2	**Typical Embedded System**: Core of the Embedded System, Sensors and Actuators, Memory, Communication Interface, Embedded Firmware, Other System Components **Characteristics and Quality Attributes of Embedded Systems**: Characteristics of an embedded system, quality attributes of embedded system.	9	CO1 CO2 CO5
	LIST OF EXPERIMENTS: 1. Write Assembly language programs involving i) General data processing instructions. ii) Multiply and Divide instructions.	6	

3	**Introduction to ARM Cortex M Processors:** What are ARM Cortex M Processors, Advantages and Applications of Cortex M Processors. **Introduction to Embedded Software Development**: Software Development flow, Compiling the applications, software flow, Input, output and peripheral accesses, Microcontroller interfaces	9	CO3 CO4 CO5
	LIST OF EXPERIMENTS: 1. Write Assembly language programs involving i)packing and unpacking instructions ii)Bit field instructions iii)Floating point instructions	6	
4	**ARM- 32 bit Microcontroller family: Cortex M4 Basics** Architecture of ARM Cortex-M4, Operation modes and states, Registers, Special Registers, Data type, Memory format, Instruction Set Summary.	9	CO3 CO4 CO5
	LIST OF EXPERIMENTS: 1. Write C programs to demonstrate serial communication using ARM Cortex M4i) "Welcome to ECE" message using UART ii) blinking LEDs	6	
5	**Hardware Software Co-Design and Program Modeling:** Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design,Introduction to Unified Modeling Language, Hardware Software Trade-offs.	9	CO4 CO5 CO6
	LIST OF EXPERIMENTS: 1. Demonstrate Interrupt operations using Cprogram i)Timer ii)Stop watch	6	

Note:

1) Programming to be done using Keil uvision 4 and download the program on to a M4 evaluation board such as STM32F nucleo boards,Tiva C Series board.
2) Experiments from 1 to 4 should include atleast 4 programs each.

Text Books:

1. Introduction to Embedded Systems, Shibu K V, 2009,TMH.
2. TheDefinitiveGuidetoARMCortex–M3andCortex-M4ProcessorsJosephYiu,3rdEdition, 2014, Elsevier.

Reference Books:

1. Embedded Systems – A contemporary Design Tool, James K Peckol, 2014, John Wiley.
2. Cortex M4 Technical Reference Manual, ARM.
3. M4 Programming manual, ST microelectronics.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	-	-	-
Apply	10	5	-	5
Analyze	5	-	5	-
Evaluate	-	-	-	5
Create	-	**5**	-	-

Practical (25 Marks)

Bloom's Taxonomy	Tests	Quizzes
Marks	**20**	**5**
Remember	5	-
Understand	5	5
Apply	10	-
Analyze	-	-
Evaluate	-	-
Create	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	-
Create	

Practical (25 Marks)

Bloom's Taxonomy	Tests
Marks	**25**
Remember	10
Understand	5
Apply	10
Analyze	-
Evaluate	-
Create	-

MICROELECTRONICS CIRCUITS			
Course Code	**:ECE63**	**Credits**	**:04**
L: P: T: S	**: 4:0:0:0**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Analyze the biasing techniques for the operation of MOSFET
CO2	Use small signal models for MOSFET configurations
CO3	Design CS amplifier configuration for real time applications and societal requirements
CO4	Determine the gain and bandwidth of MOS amplifier circuits using high frequency response
CO5	Evaluate the performance of current mirror circuits in MOS amplifier
CO6	Appraise the differential pair configuration in transistor pair to achieve the target specifications

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Biasing in MOS amplifier circuits:** Biasing by fixing VGS, Biasing by fixing VG and connecting a resistor in the source, Biasing using a drain to gate feedback resistor, biasing using a constant-current source, MOSFET circuits at DC.**MOSFET as an amplifier and switch**: Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier. Numerical Examples.	9	CO1
2	**Small – signal operation and models of MOSFETs** The DC bias point, the signal current in the drain terminal , the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the Transconductance (gm), the T Equivalent- Circuit model, Modeling the body effect and channel length modulation. **Single stage MOS amplifiers.** The CS amplifier, The CS amplifier with a source resistance, Common gate amplifier, Common drain or Source-follower amplifier, Numerical.	9	CO2 CO3
3	**Single stage IC amplifiers** **IC Biasing -** The basic MOSFET current source, current mirror, MOS current steering circuits. **High Frequency Response-General Considerations**: High frequency gain function,Determiningthe3-dBfrequencyusingopencircuittime constants, CMOS Implementation of CS Amplifier, High frequency response of CS amplifier, CG and CD amplifiers with active loads, High frequency response of CG and CD amplifiers.	9	CO2 CO4 CO5

4	**The Cascode amplifier**:The MOS Cascode, Frequency response of MOS Cascode, A Cascode Current source, Double cascoding, The Folded cascode, BiCMOS Cascode. **Current Mirror Circuits with Improved Performance**: Cascode MOS Mirrors, Bipolar mirror with Base-current Compensation, The Wilson Current Mirror, The Wilson MOS Mirror, The Widlar Current source.	9	CO2 CO4 CO5
5	**Differential Amplifiers:** The MOS Differential Pair, Small Signal Operation of the MOS Differential Pair. **Transistor Pairings**: The CD-CS, CC-CE and CD-CE Configurations, The Darlington Configurations, The CC-CB and CD-CG Configurations.	9	CO2 CO6

Text Books:

1. Microelectronic Circuits - Theory and applications, Adel S. Sedra and Kenneth C. Smith, 5thEdition, 2015, Oxford International version.

Reference Books:

1. FundamentalsofMicroelectronics,BehzadRazavi,2008,JohnWileyIndiaPvt.Ltd.
2. Microelectronics- Analysis and Design, SundaramNatarajan, 2007, Tata McGraw-Hill.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	5	-	5	-
Apply	5	5	-	5
Analyze	5	5	-	-
Evaluate	-	-	-	5
Create	5	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	5
Create	5

MICROWAVES AND RADAR			
Course Code	**:ECE64**	**Credits**	**:04**
L: P: T: S	**: 4:0:0:0**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Solve the transmission line problems using analytical and graphical approach.
CO2	Apply the knowledge of low frequency network to express Scattering parameter for impedance matching.
CO3	Analyze the working principle of microwave multiport junctions.
CO4	Categorize the radiation effects associated with RF sources.
CO5	Analyze the behavior and characteristics of microwave active components.
CO6	Select RADAR systems for the prediction of stationary and non stationary targets.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Fundamentals of Microwave and Transmission Lines:** Introduction, transmission lines equations and solutions, reflection and transmission coefficients, standing waves and SWR, line impedance and line admittance. Smith chart, impedance matching using singlestubs. Introduction to strip lines(qualitative analysis only).	9	CO1
2	**Microwave Network Theory :** Introduction, Symmetrical Z and Y parameters for reciprocal Networks, S matrix representation of multi- port networks, Properties of S parameters, S – parameters of a Two – port network with mismatched load, Comparison between [S], [Z], and [Y] matrices, Relations of Z, Y, ABCD parameters with S-Parameters.	9	CO2
3	**Microwave Passive Devices:** Introduction, Coaxial cables, connectors and adapters, Wave guide sections, matched terminations, Coaxial line to waveguide adapters, Attenuators, Phase shifters, Waveguide Tees, Magic tees, circulators and isolators, directional couplers-Bethe-hole coupler.	9	CO2 CO3

4	**Microwave Active Devices and Diodes:** Introduction, Schottky diode, PIN diode, Transfer electron devices – GUNN effect diodes,Avalanchetransittimedevices-READdiodes,IMPATTDiodes,TRAPATT Diodes, BARITT Diodes.	9	CO4 CO5
5	**RADAR AND ITS APPLICATIONS:** Basic Radar, Radar frequencies, The simple form of the Radar equation, Radar block diagram. Introduction to Doppler and MTI Radar, delay line Cancellers, digital MTI processing, Moving target detector, Pulse Doppler Radar, application of Radar.	9	CO6

Text Books:

1. Microwave Engineering, Annapurna Das,SisirK Das,2001,TMH.
2. IntroductiontoRadarsystems,MerrillISkolnik,3rdedition,2001,TMH.
3. Microwave Devices and circuits, Liao, Pearson Education.

Reference Books:

1. MicrowaveEngineering,DavidMPozar,2ndedition,2004,JohnWiley.
2. MicrowaveEngineering,ConceptsandFundamentals,AhmadShahidKhan,2014, CRC Press, Tayor and FrancisGroup.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Co-Curricular activities
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	-
Understand	10	5	-	-
Apply	5	5	-	5
Analyze	5	-	5	-
Evaluate	-	-	-	5
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	20
Apply	20
Analyze	-
Evaluate	-
Create	-

REAL TIME OPERATING SYSTEMS			
Course Code	**: ECE651**	**Credits**	**:04**
L: P: T: S	**: 3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Describe the basic concepts of Operating System
CO2	Understand and apply the basic concepts of Real Time Systems
CO3	Describe real-time Operating System requirements and design issues
CO4	Analyze the design patterns and program structures of RTOS
CO5	Appraise interaction between multiple tasks in exploiting concurrency
CO6	Evaluate common design problems and value the solutions

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	Review of Operating Systems – What operating systems do, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security Review of Real Time Embedded Systems- Real-Time Systems, Characteristics of Real Time Systems, Hard and Soft Real Time Systems. Case study: Practical Real Time System	9	CO1,CO2
2	Introduction to Real-Time Operating Systems: A Brief History of Operating Systems, Defining an RTOS, The Scheduler, Objects, Services, Key Characteristics of an RTOS. Tasks: Defining a Task, Task States and Scheduling, Typical Task Operations, Typical Task Structure, Synchronization, Communication, and Concurrency.	9	CO1, CO2, CO3
3	Real Time Kernel Objects- Semaphores: Defining Semaphores, Typical Semaphore Operations, Typical Semaphore Use. Message queues: Defining Message	9	CO4, CO5

	Queues, Message Queue States, Message Queue Content, Message Queue Storage, Typical Message Queue Operations, Typical Message Queue Use.		
4	RTOS Design Considerations-I/O sub system: Basic I/O Concepts, The I/O Sub system. Memory Management: Dynamic Memory Allocation, Fixed-Size Memory Management, Blocking vs. Non-Blocking Memory Functions, Hardware Memory Management Units	9	CO4
5	Tasks Communication and Synchronization-Synchronization, Communication, Resource Synchronization Methods, Common Practical Design Patterns. Common Design Problems: Resource Classification, Deadlocks, Priority inversion. Case study: Features of commercial RTOS :MicroC/OS-II and VxWorks	9	CO5, CO6

Text Books:

1. Operating System Concepts , Abraham Silberschatz, Peter Baer Galvin, Burlington, Greg Gagne, 9th edition, 2012, Wiley Global Education.
2. Real-Time Concepts for Embedded Systems, Qing Li with Caroline Yao, 2011, CMP Books.

Reference books:

1. Real-Time Systems, Jane W.S.Liu, 8th Impression, 2009, Pearson Education.
2. Real- Time Systems Design and Analysis, Philip A. Laplante, 3rd edition, 2004, Wiley Student Edition.
3. Real-Time Systems, C.M. Krishna, Kang G. Shin, 2010, Tata McGraw-Hill.
4. Introduction to Embedded Systems, Shibu K V, 2010, Tata McGraw Hill.

Assessment Pattern

CIE- Continuous Internal Evaluation (50Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	20	10	10	10
Remember	5			
Understand	5		5	
Apply	5	5		
Analyze	5			5
Evaluate			5	5
Create		5		

Note: Task creation/deletion/addition to be given as an assignment during the semester, and has to be evaluated for 5 marks, under "Create" category.

SEE- Semester End Examination (50Marks)

Bloom's Category	Tests
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

ANALOG AND MIXED MODE VLSI DESIGN			
Course Code	**:ECE652**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Recall the basics of Analog-to-Digital Conversion and vice versa
CO2	Discuss the different architectures of ADCs and DACs
CO3	Evaluate the process changes for the submicron layout
CO4	Employ the designs of resistors and capacitors for the submicron processes
CO5	Employ the op-amp design criteria for the submicron dimensions
CO6	Illustrate the design steps of non-linear analog circuits

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Data converter fundamentals:** Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues.	9	CO1
2	**Data Converters Architectures:** DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC.	9	CO2
3	ADC Architectures, Flash ADC, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.	9	CO2
4	**Sub-Micron CMOS circuit design:** Process Flow, Capacitors and Resistors, MOSFET Switch, Delay and adder Elements, Analog Circuits MOSFET Biasing, OP-Amp Design.	9	CO3 CO4 CO5
5	**Non-Linear Analog Circuits**: Basic CMOS Comparator Design, Analog Multipliers, Multiplying Quad, Level Shifting.	9	CO6

Text Books:

1. Design,Layout,Simulation,R.JacobBaker,HarryWLi,DavidEBoyce,PHIEducation, 2005.

2. CMOS- MixedSignalCircuitDesign,R.JacobBaker,JohnWileyIndiaPvt.Ltd,2008.

Reference Books:

1. DesignofAnalogCMOSIntegratedCircuits,BRazavi,FirstEdition,McGrawHill,2001.
2. CMOSAnalogCircuitDesign,PEAllenandDRHolberg,2nd Edition,OxfordUniversity Press,2002.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	5	-	5	-
Understand	5	5	-	5
Apply	10	-	5	-
Analyze	-	5	-	-
Evaluate	-	-	-	5
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
MarECs	**50**
Remember	10
Understand	10
Apply	15
Analyze	10
Evaluate	5
Create	-

COMPUTER COMMUNICATION NETWORKS			
Course Code	**:ECE653**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	**To understand the concepts of the OSI and TCP/IP reference model**
CO2	**To understand the concept of local area networks their topologies protocols and applications**
CO3	**Understand the need for process to process delivery ,the issues associated with it and methods to handle them**
CO4	**Analyze the design procedures for communication between adjacent nodes and resolving access to shared media**
CO5	**Analyze the network requirements and design, calculate and apply subnet masks and addresses**
CO6	**Apply the concepts of OSI and TCP/IP protocols to real time applications**

Mapping of Course Outcomes to Program Outcomes:

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

Sl no	**Contents of Module**	**Hours**	**COs**
1	**Introduction: Layered tasks, OSI model, Layers in OSI model, TCP/IP suite, Addressing. Bandwidth utilization: multiplexing and spread spectrum**	**9**	**CO1**
2	**Data Link Control: Framing, Flow and error control, Protocols- noiseless channel and noisy channels, HDLC,PPP** **Multiple Accesses: Random access, Controlled access, Channelization**	**9**	**CO3, CO4**
3	**Wired LAN: Ethernet, IEEE standards, Standard Ethernet, Changes in the standard, Fast Ethernet, Gigabit Ethernet** **Wireless LAN IEEE802.11, Bluetooth, Connecting LANS, Connecting devices, Backbone networks and Virtual LAN**	**9**	**CO2**
4	**Network Layer: Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 Transition from Ipv4 to Ipv6. Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols.**	**9**	**CO2**
5	**Transport layer: Process to process Delivery,World Wide web-Hypertext Transfer Protocol-File Transfer Protocol-Electronic Mail- TELNET,UDP, TCP, Domain name system, Resolution.**	**9**	**CO3, CO6**

TEXT BOOKS:

1. Data Communications and Networking, 5/eBehrouz A. Forouzan, 5th edition,2013, McGraw-Hill Higher Education.

REFERENCE BOOKS:

Computer Networking: A Top-Down Approach, James Kurose, Keith Ross, 7th edition, 2017, Pearson education.

Introduction to Data communication and Networking, Wayne Tomasi, 2007, Pearson education.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	20	10	10	10
Remember	10	-	5	-
Understand	10	5	-	-
Apply	-	5	-	5
Analyze	-	-	5	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE- Semester End Examination (50 Marks)

Bloom's Category	Tests
Remember	10
Understand	15
Apply	20
Analyze	5
Evaluate	-
Create	-

OBJECT ORIENTED PROGRAMMING			
Course Code	**:ECE654**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Distinguish between structure oriented programming and object oriented programming
CO2	Analyze functions to improve the code modularity and reusability
CO3	Apply the concepts of objects, classes and inheritance in object oriented programming
CO4	Examine the programs on operator-overloading technique
CO5	Choose the exception handling techniques in real time programming
CO6	Engage students for life long learning and work on multidisciplinary projects.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction:** Overview of C++, Sample C++ program, Different data types, operators, expressions, and statements, arrays and strings, pointers & user-defined types.	9	CO1
2	**Functions:** Introduction, Function definition and its prototype, function with empty parameter list, inline function, references and reference parameters, default arguments, function overloading and templates, recursion.	9	CO1 CO2
3	**Introduction to class:** Defining a class with member function, defining a member function with a parameter, data members, set and get member function, initializing objects with constructor, time class case study, class scope and assessing class members, access and utility functions, constructor with default arguments, destructor, when constructors and destructor are called, Time class case study, default member wise assignment, const objects and const member functions, friend function and friend class using this pointer.	9	CO1 CO2 CO3 CO6
4	**Operator Overloading:** Introduction and Fundamentals of overloading, overloading of binary and unary operators, overloading of prefix and post fix operators, Dynamic memory management. **Exception Handling:** Introduction, Example: Handling an attempt to divide by zero, re throwing an exception, stack unwinding, when to use exception handling, constructor, destructor and exception handling, exception and inheritance.	9	CO1 CO4 CO5 CO6

5	**Inheritance:** Introduction, Base-Class Access Control, Inheritance and protected Members, Inheriting Multiple Base Classes, Constructors, Destructors, and Inheritance	9	CO1 CO2 CO3 CO6

Text Books:

1. C++ - How to program, Paul deitel and Harvey deitel, 9th Edition, 2014, Pearson.
2. TheCompleteReferenceC++,HerbertSchildt,4th Edition,2003,TataMcGrawHill.

Reference Books:

1. C++ Primer, Stanley B. Lippman, JoséeLajoie, Barbara E. Moo, 5th Edition, 2012, Addison Wesley.
2. The C++ programming language, Bjarne Stroustrup, 4th Edition, 2013, Pearson.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	5	-	5	-
Understand	5	-	-	5
Apply	10	10	5	-
Analyze	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	5

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

IMAGE PROCESSING			
Course Code	**:ECE655**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	State the various steps and components of a general purpose image processing system.
CO2	Explain the various types of image acquisition techniques and representation of image.
CO3	Demonstrate the various mathematical transforms that are required to be applied for processing the image.
CO4	Compare different spatial and frequency domain image enhancement algorithms.
CO5	Appraise 2-D filtering and image restoration techniques.
CO6	Design different segmentation techniques.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction and Fundamentals :** Definition and origins ofDigital Image Processing, Fundamentals steps involved in digital image processing, Components of an Image Processing System, Elements of visual perception, Image Sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and nonlinear operators.	9	CO1 CO2
2	**Image Transforms:** Two dimensional Orthogonal and unitary Transforms, Properties of Unitary Transforms, 1D-DFT,2D-DFT, DCT, DST, Hadamard Transform.	9	CO3
3	**Image Enhancement :** Image Enhancement in Spatial domain - Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Basics of spatial filtering, smoothing and sharpening spatial filters, combining spatial enhancement methods, Frequency–domain enhancement–smoothing and sharpening frequency – domain filters, Homomorphic filtering.	9	CO4
4	**Image Restoration:** A model of the image degradation/restoration process, Noise models, Restoration in the presence of noise only-spatial filtering, periodic noise reduction by frequency domain filtering, linear, positioninvariantdegradations,estimationofthedegradationfunction,inverse filtering, MMSE (Wiener) Filtering.	9	CO5

5	**Image Segmentation:** Detection of Discontinuities, Edge linking and boundary detection, thresholding, Region-based segmentation, Segmentation by morphological watersheds.	9	CO6

Text Books:

1. Digital Image Processing, R C. Gonzalez, R. E. Woods, 3rd Edition, 2015, Pearson EducationIndia.
2. Fundamentals of Digital Image Processing, Anil K. Jain, 1st Edition, 2014, Pearson EducationIndia.

Reference Books:

1. Digital Image ProcessingandAnalysis,B.ChandaandD.Majumdar,1stEdition,2014, PHI Learning Private Limited.
2. Digital Image Processing, Madhuri Joshi, 1st Edition, 2015, PHI Learning Private Limited.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	5	5	-	-
Understand	5	5	5	-
Apply	5	-	5	5
Analyze	5	-	-	5
Evaluate	-	-	-	-
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	50
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	-
Create	-

DIGITAL SWITCHING SYSTEMS			
Course Code	**:ECE656**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

Course Outcomes: At the end of the Course, the student will have the ability to:

CO1	Understand the basic concepts of telecommunications
CO2	Categorize the types of switching systems
CO3	Demonstrate the model of digital switching system
CO4	Evaluate the telecommunications traffic model considering societal cause
CO5	Examine the methods of grading and Time Division switching
CO6	Analyze the software aspects of switching system

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction:** Developments of telecommunications, Network structure, Network services, terminology, Regulation, Standards. Introduction to telecommunications transmission, Power levels, Four wire circuits, Digital transmission, FDM, TDM, PDH and SDH, Transmission performance. **Evolution of switching systems:** Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronic switching, Digital switching systems.	9	CO1 CO2
2	**Digital switching systems:** Fundamentals, Purpose of analysis, Basic central office linkages, Outside plant versus inside plant, Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Digital switching system fundamentals, Building blocks of a digital switching system, Basic call processing. **A Generic Digital switching system Model:** Introduction, Scope, Hardware architecture, Software architecture, Recovery strategy, Simple call through a digital system, Common characteristics of digital switching systems.	9	CO3
3	**Telecommunications Traffic:** Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems.	9	CO4

4	**Switching Systems:** Introduction, Single stage networks, Gradings, Link Systems, GOS of Linked systems. **Time Division Switching:** Introduction, space and time switching, Time switching networks, Synchronization.	9	CO5
5	**Switching system software:** Introduction, Scope, Basic software architecture, Operating systems, Database Management, Concept of generic program, Software architecture for level 1 control, Software architecture for level 2 control, Software architecture for level 3 control, Digital switching system software classification, Call models, Connect sequence, Software linkages during call, Call features, Feature flow diagram, Feature interaction.	9	CO6

Text Books:

1. TelecommunicationandSwitching, TrafficandNetworks, JEFlood, 2002,Pearson Education.
2. Digital Switching Systems, Syed R. Ali, 2002,TMH.

Reference Books:

1. Digital Telephony, John C Bellamy, 3rd edition, 2008, Wiley India India Pvt. Ltd.
2. Telecommunication Switching Systems And Networks, Thyagarajan Viswanathan, 1992, PHI Learning.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes	Self - Study
Marks	**20**	**10**	**10**	**10**
Remember	5	-	-	-
Understand	5	-	5	-
Apply	5	5	-	5
Analyze	5	-	5	5
Evaluate	-	5	-	-
Create	-	-	-	-

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

MINI PROJECT-IV			
Course Code	**:ECE67**	**Credits**	**:02**
L: P: T: S	**:0:2:0:0**	**CIE Marks**	**:25**
Exam Hours	**:03**	**SEE Marks**	**:25**

The student will have the ability to

	Course outcomes
CO1	Identify technical aspects of the chosen project with a comprehensive and systematic approach
CO2	Review the literature and develop solutions for problem statement
CO3	Work as an individual or in a team in development of technical projects
CO4	Test the various phases of planned project
CO5	Articulate the project related activities and findings
CO6	Extend or use the idea in mini project for major project

Mapping of Course Outcomes to Program Outcomes:

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

APPENDIX A

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

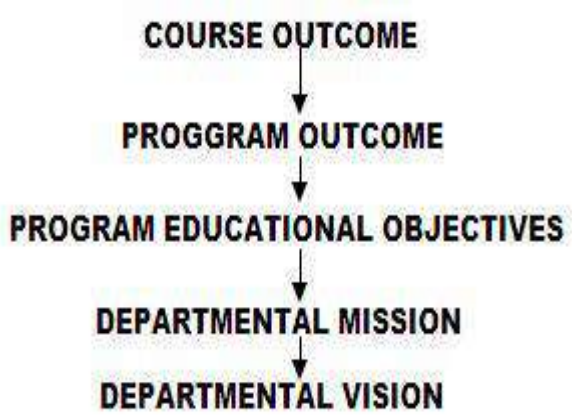
There are three educational Outcomes as defined by the National Board of Accreditation:

Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]

Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C

Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes

Mapping of Outcomes



APPENDIX B

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Design/development of solutions: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Conduct investigations of complex problems: The problems that cannot be solved by straight forward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies.