NEW HORIZON COLLEGE OF ENGINEERING

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Scheme & Syllabus

Third Year BE

Academic Year 2022-23

New Horizon College of Engineering

Department of Electronics and Communication Engineering

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 in Electronics and Communication.
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 work**	**PO9:** Function effectively as an individual, and as a member or leader in 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
Department of Electronics and Communication Engineering
Scheme of Fifth Semester (Autonomous)
B.E Program – Batch: 2020-2024
Academic Year 2022-2023 (ODD)

Semester V

Sl. No.	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20ECE51	Analog Communication	ECE	3	0	0	0	3	3	50	50	100
2	20ECE52	Microprocessors	ECE	3	0	0	0	3	3	50	50	100
3	20ECE53	CMOS VLSI Design	ECE	3	0	0	0	3	3	50	50	100
4	20ECE54	Information Theory and Coding	ECE	3	0	0	0	3	3	50	50	100
5	20ECE55	Engineering Electromagnetics	ECE	2	1	0	0	3	4	50	50	100
6	**20ECE56X**	**Professional Elective-I**	ECE	3	0	0	0	3	3	50	50	100
	20ECE561	Real Time Systems	ECE									
	20ECE562	Semiconductor Device Physics	ECE									
	20ECE563	Introduction to MEMS	ECE									
	20ECE564	DSP Algorithms & Architecture	ECE									
	20ECE565	Microcontrollers	ECE									
	20ECE566	Routing and Switching -01	ECE									
7	20ECL57	Microprocessors Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
8	20ECL58	CMOS VLSI Design Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
9	20ECL59B	Mini project-III	ECE	0	0	2	0	2	4	50	50	100
							Total	**23**	**29**	**400**	**400**	**800**

New Horizon College of Engineering
Department of Electronics and Communication Engineering
Scheme of Sixth Semester (Autonomous)
B.E Program – Batch: 2020-2024
Academic Year 2022-2023 (EVEN)

Semester VI

Sl. No.	Course Code	Course	BOS	Credit Distribution				Overall Credits	Contact hours	Marks		
				L	T	P	S			CIE	SEE	Total
1	20ECE61	Digital Communication	ECE	3	0	0	0	3	3	50	50	100
2	20ECE62	Embedded System Design	ECE	3	0	0	0	3	3	50	50	100
3	20ECE63	Microelectronic Circuits	ECE	3	0	0	0	3	3	50	50	100
4	**20ECE64X**	**Professional Elective-II**	ECE	3	0	0	0	3	3	50	50	100
	20ECE641	Microwaves and Radar	ECE									
	20ECE642	Nanoelectronics	ECE									
	20ECE643	Digital Switching Systems	ECE									
	20ECE644	Automotive Electronics	ECE									
	20ECE645	IoT and Wireless Sensor Networks	ECE									
	20ECE646	Multimedia Communication	ECE									
5	**20ECE65X**	**Professional Elective-III**	ECE	3	0	0	0	3	3	50	50	100
	20ECE651	Real Time Operating Systems	ECE									
	20ECE652	Analog and Mixed mode VLSI Design	ECE									
	20ECE653	Computer Communication Networks	ECE									
	20ECE654	Image Processing	ECE									
	20ECE655	Programming with data structures and OOP	ECE									
	20ECE656	Power Electronics	ECE									
6	20ECL66	Communication Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
7	20ECL67	Embedded System Design Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
8	20ECL68B	Mini project-IV	ECE	0	0	2	0	2	4	50	50	100
9	**20NHOPXXX**	**Open Elective-I**	ECE	3	0	0	0	3	3	50	50	100
	20NHOP609	CISCO - Routing and Switching - I	ECE									
	20NHOP622A	Programming the Industrial Robot	ECE									
	20NHOP623A	5G Mobile Communication	ECE									
	20NHOP625A	VLSI Physical Design - I	ECE									
							Total	**23**	**28**	**400**	**400**	**800**

FIFTH SEMESTER

(SYLLABUS)

ANALOG COMMUNICATION

Course Code : 20ECE51 | **Credits : 3**
L: T: P: S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 3 Hrs | **SEE Marks : 50**

Course Outcomes: At the end of the Course, the student will be able 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	Analyze the effect of noise in Analog modulation systems
CO6	Examine the statistical averages associated with random processes

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**AMPLITUDE MODULATION:** Amplitude Modulation-Time domain and 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 and Frequency Domain description of DSB-SC wave, Generation of DSB-SC wave- Balanced modulator, Detection of DSB-SC wave - Costas Loop. **FOURIER ANALYSIS:** Fourier Transform, Properties, Interplay between time domain and frequency domain descriptions. Text-1: 2.2,2.3,2.4, 7.1, 7.2	**9 Hrs**	**CO1,CO2,CO4**
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. Text-2: A2.3, A2.4 Text-1: 3.5, 7.4	**9 Hrs**	**CO1,CO2, CO3,CO4**
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. Text-1: 7.5,7.6,7.8,7.9	**9 Hrs**	**CO1,CO2 CO3,CO4**
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. Text-1: 7.10,7.11,7.12	**9 Hrs**	**CO1,CO2,CO4**

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 Figure, Equivalent Noise temperature, Cascade connection of Two-port networks. Noise in CW Modulation Systems: Noise in AM Receivers, Noise in FM Receivers, Pre-emphasis and De-emphasis in FM. Text-1: 8.5,8.7,8.9,8.12, 9.8 Text-2: 1.9, 8.4, 2.10, 2.12, 2.13 Text-3: 5.5,5.6,5.8,5.9,6.4,6.5,6.6	**9 Hrs**	**CO5,CO6**

TEXT BOOKS:

1. An Introduction to Analog and Digital Communication, Simon Haykin, John Wiley India Pvt. Ltd, 2008.
2. Communication Systems, Simon Haykin, 5th Edition, 2009, John Wiley India Pvt. Ltd.
3. Communication Systems, Simon Haykin, Michael Moher, 5th Edition, 2019, Wiley

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.

Mapping of CO v/s PSO:

COs	**PSO1**	**PSO2**
20ECE51	**Analog Communication**	
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

MICROPROCESSORS

Course Code : 20ECE52 | **Credits : 03**
L: T: P: S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

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

CO1	Explain the functional features of 8086 Microprocessor
CO2	Apply the knowledge of addressing modes to write assembly language program in 8086
CO3	Make use of assembler directives and interrupt methods in 8086 programming
CO4	Examine the timing diagrams using minimum and maximum mode configuration of 8086
CO5	Demonstrate the peripheral Interfacing concepts in 8086
CO6	Appraise the architectural features of 8051 Microcontroller to develop assembly language program

Mapping of Course Outcomes to Program Outcomes

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

Module No	Module Contents	Hours	COs
1	**ARCHITECTURE OF 8086** - Functional Block Diagram and Description - Addressing Modes, Machine language instruction formats, Instruction set.	9	CO1,CO2
	Text-1: 2.12,2.13,2.14,2.15,2.16, Text-2: 2.1, 2.2, 2.3		
2	**ASSEMBLY LANGUAGE PROGRAMMING**: 8086 Simple Assembly Language Programming, Assembler Directives, Interrupts, Interrupt cycle of 8086 and Interrupt Service Routines.	9	CO3
	Text-1: 6.30 -6.36 Text-2: 2.4, 4.3, 4.4, 4.5, 4.6, 4.7		
3	**8086 BUS CONFIGURATION AND TIMINGS:** Pin Diagram of 8086,Memory Organization , Minimum Mode and Timing diagrams, Maximum Mode and Timing diagrams, Memory Interfacing, Coprocessor-8087	9	CO4
	Text-2: 1.3,1.4, 1.8,1.9, 5.1.1, 8.3		
4	**PERIPHERAL INTERFACING&APPLICATION:** Programmable Peripheral Interface (8255), Keyboard Display controller (8279), Programmable interrupt controller (8259), Programmable DMA Controller(8257),	9	CO5
	Text-2: 5.4,5.5,6.2,6.3,7.1.7.2		
5	**MICROCONTROLLER** 8051 – Architecture, Special Function Registers (SFRs), I/O Pins Ports and Circuits, Instruction set, Addressing modes, Assembly language programming.	9	CO6
	Text 3 : 3.1,3.2, 5.0-5.6, 6.0-6.4,7.0-7.7		

TEXT BOOKS:

1. Microprocessor and Interfacing- Douglas V Hall, SSSP Rao, 3rd edition, TMH, 2012.
2. Advanced Microprocessors and Peripherals- A.K. Ray and K.M. Bhurchandi, TMH, 3rd Edition, 2015.
3. The 8051 Microcontroller and Embedded Systems – using assembly and C , Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay, 2nd Edition, 2013,Pearson.

REFERENCE BOOKS:

1. Microcomputer systems-The 8086 / 8088 Family – Y.C. Liu and A.Gibson, 2nd edition, PHI - 2003.
2. The Intel Microprocessor, Architecture, Programming and Interfacing - Barry B. Brey, 6e, Pearson Education / PHI, 2003.
3. The 8086 Microprocessor: Programming & Interfacing the PC -Kenneth J Ayala, CENGAGE Learning, 2011

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE52	**Microprocessors**	
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	-
CO5	3	-
CO6	3	-

Assessment Pattern

Sl. No.	Description	Type
1.	Student Assignment	Direct
2.	Internal assessment	Direct
3.	University exam	Direct
4.	Student feedback	Indirect
5.	Alumni feedback	Indirect
6.	Employers feedback	Indirect

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

CMOS VLSI DESIGN

Course Code : 20ECE53
L: T: P: S : 3:0:0:0
Exam Hours : 3

Credits : 3
CIE Marks : 50
SEE Marks : 50

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

CO1	Describe the basic concepts of MOSFET and its generic model
CO2	Identify the process sequence for the fabrication of ICs and the relevant layout design rules
CO3	Employ the delay model to the combinational MOS circuits
CO4	Distinguish between the various combinational circuit designs that are in usage
CO5	Examine the sequential circuits in terms of the delay constraints
CO6	Evaluate the Combinational and Sequential Circuits in terms of timing

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**MOS Transistors**: Introduction, MOS transistors, CMOS Logic, Design portioning **MOS Transistor Theory:** Introduction, Long-Channel I-V characteristics, C-V Characteristics - Simple MOS Capacitance Models, Non-ideal I-V effects, DC transfer characteristics Text-1: 1.3, 1.4, 1.6, 2.1, 2.2, 2.3 (up to 2.3.1), 2.4, 2.5	9	**CO1**
2	**CMOS Processing Technology:** CMOS Fabrication and Layout**,** Exercises for stick diagram and layout, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements Text-1: 1.5, 3.1, 3.2, 3.3, 3.4	9	**CO2**
3	**Delay:** Introduction, Transient Response, RC Delay Model - Effective Resistance, Gate and Diffusion Capacitance, Equivalent RC Circuits, Transient Response, Elmore Delay, Layout Dependence of Capacitance, Linear Delay Model - Logical Effort, Parasitic Delay, Delay in a Logic Gate, Drive **Combinational Circuit Basics:** Introduction, Circuit Families - Static CMOS Text-1: 4.1, 4.2, 4.3 (excluding 4.3.7), 4.4 (up to 4.4.4) Text-1: 9.1, 9.2 (up to 9.2.1)	9	**CO3, CO4**
4	**Combinational Circuit Design:** Circuit Families - Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits- Domino Logic, Silicon-On-Insulator Circuit Design **Sequential Circuit Design:** Introduction, Sequencing Static Circuits, Circuit Design of Latches and Flip-Flops - Conventional CMOS Latches ,Conventional CMOS Flip-Flops, Pulsed Latches, Resettable Latches and Flip-Flops Text-1: 9.2 (up to 9.2.4.1), 9.5, 10.1, 10.2, 10.3 (up to 10.3.4)	9	**CO4, CO5**
5	**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, Timing Terms - Analysis - Models - Goals, Static Timing Analysis, Timing Constraints & Verification, Timing Convergence, Timing driven Logic and Layout Synthesis. Text-2:10.1 till 10.6, 10.8 till 10.10, 10.12 till 10.15, 10.19 till 10.39	9	**CO6**

TEXT BOOKS:

1. "CMOS VLSI Design – A Circuits and Systems Perspective", Neil H. E. Weste, David Money Harris, 4th Edition, Pearson Education, 2015
2. VLSI Design, Debaprasad Das, 2nd edition, 2016, Oxford University Press.

REFERENCE BOOKS:

1. CMOS Digital Integrated Circuits, Analysis and Design, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, 2007, TMH.
2. Digital Integrated Circuits – A design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Edition, 2009, Prentice-Hall.
3. Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd Edition, 2011, PHI.
4. Static Timing Analysis for Nanometer Designs - A Practical Approach, J. Bhasker, Rakesh Chadha, Springer, 2009

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE53	CMOS VLSI Design	
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

INFORMATION THEORY AND CODING

Course Code : 20ECE54 **Credits : 3**
L: T: P: S : 3:0: 0:0 **CIE Marks : 50**
Exam Hours : 3 hrs **SEE Marks : 50**

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

CO1	Explain the nature of information and its measure using uncertainty and entropy
CO2	Categorize the types of channel and compute their corresponding capacities
CO3	Analyze 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	Evaluate the performance of source and channel coding techniques
CO6	Estimate the error detection and correction capabilities of channel codes for error free communication

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Information Theory:** Introduction, Information and its property, Measure of information, Entropy and its property, Mark off statistical model for information source, Entropy and information n rate of mark-off source.	9	CO1
	Text – 1 – 4.1, 4.2 Text – 2 – 2.1 Text – 3 – 10.1,10.2		
2	**Channel classification and Capacity:** Joint and Conditional Entropy, Mutual Information and its property, Channel capacity theorem, Continuous and Discrete Communication channels – Discrete memory less channels - channel representations - noiseless channel, lossless channels, Deterministic, Binary symmetric channel (BSC), Binary Erasure channel (BEC) and their capacities.	9	CO2, CO3
	Text – 1 – 4.4, 4.5, 4.6 Text – 2 - 2.4, 2.5, 2.6, 2.7, 2.8, 2.9 Text – 3 – 10.6,10.7,10.8,		
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 theorems, Shannon binary Encoding, Shannon- Fano Encoding, Huffman Coding: minimum and maximum variance method.	9	CO2, CO3
	Text – 1 – 4.3 Text – 2 - 2.2, 2.3 Text – 3 – 10.3		
4	**Error Control Coding:** Introduction, Types of Errors, Methods of controlling errors, Types of Codes, Linear Block Codes: Encoding circuit and Syndrome circuit, Error Detection and Error Correction Capabilities of Linear Block codes, Single error correcting Hamming codes.	9	CO4, CO5, CO6
	Text – 1 – 9.1, 9.2 Text – 2 – 8.1,8.2,8.3 Text 3 – 10.10,10.11		
5	**Cyclic and Convolutional Codes:** Binary Cyclic codes, Encoding using Shift register, Syndrome Calculation, Error detection and Error correction of cyclic codes, CRC Codes. Convolutional Encoders using Time domain and Transform Domain approach, Code tree, Trellis and State diagram, Maximum Likelihood decoding of Convolutional codes-Viterbi Algorithm.	9	CO4, CO5, CO6
	Text – 1 – 9.3, 9.6, 9.7, 9.8 Text – 2 – 8.4, 8.5, 8.6, 8.7, 8.8, 8.9 Text – 3 –10.12,10.13		

TEXT BOOKS:

1. Digital and analog communication systems, K. Sam Shanmugam, Wiley India Pvt. Ltd.,2017.
2. Digital Communications, Simon Haykin,Wiley India Pvt. Ltd.,2017.
3. Communication Systems, Simon Haykin, Wiley India Pvt. Ltd., , 5th edition, 2019.

REFERENCE BOOKS:

1. Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, 2012.
2. Elements of Information Theory, Thomas M. Cover and Joy A. Thomas, John Wiley and Sons, 2004.
3. Digital Communications: Fundamentals & Applications, Bernard Sklar, 2nd edition, 2009.
4. Information Theory and Cryptography, Arijit Saha, Nilotpal Manna, Surajit Mandal Pearson ,2013.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE54	INFORMATION THEORY AND CODING	
CO1	3	-
CO2	3	2
CO3	3	-
CO4	3	2
CO5	3	-
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	-
Understand	5	7.5	-
Apply	10	7.5	5
Analyze	5	-	5
Evaluate	-	-	-
Create	-	-	-

SEE- Semester End Examination (50 Marks)

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

ENGINEERING ELECTROMAGNETICS

Course Code : 20ECE55 **Credits : 3**
L: T: P: S : 2:1:0:0 **CIE Marks : 50**
Exam Hours : 3 **SEE Marks : 50**

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

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

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Coulomb's Law, Electric Field Intensity, Flux density Gauss's law and Divergence** Vector Analysis, Experimental law of Coulomb, Electric field intensity, Field due to infinite line charge, Electric flux density and Gauss law , Concept of Divergence, Maxwell's First equation (Electrostatics) and divergence theorem. Text-1: Chapter 1, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 3.5, 3.6, 3.7	9	**CO1,** **CO2**
2	**Potential and current** Definition of potential and potential difference, potential gradient, Current and current density, Concept of Continuity equation, Conductor properties and boundary conditions **Poisson's and Laplace's Equations** Concept of capacitance, Derivation of Poisson's and Laplace's Equations, Examples of the solution of Laplace's equation: Parallel plate capacitor, Co-axial cable and spherical capacitor. Text-1: 4.3, 4.6, 5.1, 5.2, 5.4, 6.3, 7.1, 7.3.	9	**CO3,** **CO4**
3	**Steady Magnetic Field** Biot-Savart Law and its application: Magnetic Field due to straight current carrying conductor, Ampere's circuital law and its application: Magnetic Field due to co-axial cable , Concept of Curl, Stokes' theorem, Scalar and Vector Magnetic Potentials. **Magnetic Materials and Inductance** Magnetic circuits , Inductance and mutual inductance Text-1: 8.1, 8.2 , 8.3, 8.4 , 8.6 , 9.8 , 9.10	9	**CO1,** **CO2,** **CO4**
4	**Time-varying fields and Maxwell's equations** Faraday's law, displacement current, Maxwell's equations in point form, Maxwell's equations in integral form. Text-1: 10.1, 10.2, 10.3, 10.4	9	**CO5**
5	**Uniform Plane Wave** Wave propagation in free space, dielectrics and good conductors. Poynting's theorem and wave power, Skin Effect, Reflection of uniform plane waves at normal incidence and Standing wave ratio Text-1: 12.1, 12.2, 12.3, 12.4, 13.1, 13.2		**CO6**

TEXT BOOK:

1. W.H. Hayt and J.A. Buck, "Engineering Electromagnetics ", 7th Edition, Tata McGraw-Hill, 2009, ISBN-978-0-07-061223-5.

REFERENCE BOOKS:

1. John Krauss and Daniel A Fleisch, " Electromagnetics with applications", McGraw- Hill.

2. N. Narayana Rao, " Fundamentals of Electromagnetics for Engineering" , Pearson.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE55	**Engineering Electromagnetics**	
CO1	3	-
CO2	3	-
CO3	-	2
CO4	3	-
CO5	3	-
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks	**25**	**15**	**10**
Remember			2
Understand	5	5	6
Apply	15	5	2
Analyze	10	5	
Evaluate			
Create			

SEE- Semester End Examination (50 Marks)

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

REAL TIME SYSTEMS

Course Code : 20ECE561 | **Credits : 03**
L:P:T:S : 3:0:0:0 | **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 functions within the 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	Appraise the design and development framework of RTS
CO6	Select suitable methodology to increase the efficiency of Real-Time systems

Mapping of Course Outcomes to Program Outcomes:

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

SYLLABUS			
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. (Text Book 1: 1.2 to 1.4 and 2.1 to 2.3)	**9**	**CO1**
2	**Task Assignment and Scheduling** - Classical Uniprocessor scheduling algorithms, Uniprocessor scheduling of IRIS Tasks, Task Assignment, Mode Changes, and Fault Tolerant Scheduling. (Text Book 1: 3.2 to 3.6)	**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 Error (Exception) handling, Overloading and Generics, Multitasking, Low Level programming, Task scheduling, Timing Specifications, Programming Environments, Run-time Support. (Text Book 1: 4.2 to 4.15)	**9**	**CO3, CO5**
4	**REAL TIME DATABASES** Real time Databases - Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency Control Issues, Disk Scheduling Algorithms, Two-phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time systems. (Text Book 1: 5.2 to 5.11)	**9**	**CO4**
5	**DESIGN OF RTS** – General Introduction: Introduction, Specification Document, Preliminary Design, Single-Program Approach, Foreground/Background System. **RTS DEVELOPMENT METHODOLOGIES**: Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method. (Text Book 2: 7.1 to 7.5 and 8.1, 8.2, 8.4,8.5)	**9**	**CO5, CO6**

Text Books:

1. Real-Time Systems, C.M. Krishna, Kang G. Shin, 2010, Tata McGraw-Hill Edition.
2. Real Time Computer Control-An Introduction, Stuart Bennett, 3rd edition, 2009, Pearson Education Ltd.

Reference books:

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

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE561	**Real Time Systems**	
CO1	3	-
CO2	-	3
CO3	-	-
CO4	3	-
CO5	3	3
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**25**	**15**	**10**
Remember	5	-	-
Understand	5	-	5
Apply	5	7.5	-
Analyze	5	7.5	-
Evaluate	5	-	5
Create	-	-	-

SEE- Semester End Examination (50Marks)

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

SEMICONDUCTOR DEVICE PHYSICS

Course Code : 20ECE562 | **Credits : 3**
L: T: P: S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 3 Hrs | **SEE Marks : 50**

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

CO1	Describe the principles and fundamentals of semiconductor, along with the crystal structures of semiconductor devices
CO2	Explain the principles of atomic structure and its formulation by using the basics of Quantum mechanics
CO3	Analyze 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:

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

Module No	Module Contents	Hours	COs
1	**CRYSTAL PROPERTIES AND GROWTH OF SEMICONDUCTORS** Semiconductor Materials Crystal Lattices Periodic Structures Cubic Lattices Planes and Directions The Diamond Lattice 10 Bulk 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. Hetero junctions	**9**	**CO4**
4	**BIPOLAR JUNCTION TRANSISTORS:** Fundamentals of BJT Operation. Amplification with BJTs. BJT Fabrication Minority Carrier Distributions and Terminal Currentsolution of the	**9**	**CO5**

	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. Heterojunctions Bipolar Transistors.		
5	**FIELD-EFFECT TRANSISTORS**: 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-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.	**9**	**CO6**

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.
2. Semiconductor Physics and Devices Basic Principles. Donald A Neamen. Third Edition. TMH Publications.
3. Introduction to Solid State Physics. Charles Kittel. Seventh Edition.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE562	**SEMICONDUCTOR DEVICE PHYSICS**	
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-
CO6	3	-

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	SEE Marks
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

INTRODUCTION TO MEMS

Course Code : 20ECE563 | **Credits : 3**
L: T: P: S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks : 50**

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

CO1	Inspect new materials, science and technology for MEMS applications
CO2	Examine design and fabrication processes involved with MEMS
CO3	Analyse the Dynamics and modelling of Microsystems using suitable to mathematical models
CO4	Evaluate various scaling laws in Miniaturization involved with MEMS
CO5	Categorize state-of-the-art lithography techniques for MEMS System
CO6	Make use of micro sensors and micro actuators for designing sustainable MEMS system

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Overview of MEMS and Microsystems:** MEMS and Micro system, Typical MEMS and Microsystems Products, Evolution of Micro fabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization. Applications and Markets. Text-1: Chapter 1 : 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	9	**CO1,C06**
2	**Working Principles of Microsystems:** Introduction, Micro sensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Micro fluidics. **Engineering Science for Microsystems Design and Fabrication**: Introduction, Molecular Theory of Matter and Inter-molecular Forces, Plasma Physics, Electrochemistry. Text-1: Chapter 2 : 2.1,2.2,2.3,2.4,2.5,2.6 Text-1: Chapter 3 : 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8	9	**CO2,C06**
3	**Engineering Mechanics for Microsystems Design:** Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis. Text-1: Chapter 4 : 4.1,4.2,4.3,4.4,4.5,4.6,4.7	9	**CO3**
4	**Scaling Laws in Miniaturization:** Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Fluid Mechanics, Scaling in Heat Transfer. Text-1: Chapter 6 : 6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8	9	**CO4**
5	**Overview of Micro manufacturing:** Introduction, Bulk Micro manufacturing, Surface Micromachining, The LIGA Process, Summary on Micro manufacturing. Text-1: Chapter 9 : 9.1,9.2,9.3,9.4,9.5	9	**CO5**

TEXT BOOKS:

1. Tai-Ran Hsu, MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering, 2nd Ed, Wiley.

REFERENCE BOOKS:

1. Hans H. Gatzen, Volker Saile, JurgLeuthold, Micro and Nano Fabrication: Tools and Processes, Springer, 2015.
2. Dilip Kumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cenage Learning.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE563	**INTRODUCTION TO MEMS**	
CO1	-	-
CO2	-	2
CO3	-	-
CO4	3	-
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

DSP ALGORITHMS AND ARCHITECTURE

Course Code : 20ECE564 | **Credits : 3**
L: T: P: S : 3:0:0:0 | **CIE Marks : 50**
Exam Hours : 3 hours | **SEE Marks : 50**

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

CO1	Analyze the architecture of digital signal processors
CO2	Recognize the fundamentals of fixed and floating point architecture of various DSPs
CO3	Develop the programming knowledge using the instruction set of DSP processor
CO4	Analyze the signal processing algorithms in DSP
CO5	Apply the signal architecture in embedded applications
CO6	Appraise the real time applications of DSP processor

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	Cos
1	**Introduction to architectural features of DSP Processors:** Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution. Text Book1 : 4.1,4.2,4.3,4.4,4.5,4.6,4.7	9	**CO1**
2	**Programmable DSP Processor**: Architecture, Data Addressing Modes of TMS32O54XX, Memory Space of TMS32OC54xx Processor, Instruction set and Programming,, Pipeline Operation of DSP Processor, Introduction to TMS320C6713 DSP Processor Text Book1 :5.3,5.4,5.5,5.7,5.10 Text Book 2 :10.1,10.3	9	**CO2,CO3**
3	**Implementation of DSP Algorithms**: FIR Filters, IIR Filters, Interpolation and Decimation Filters, FFT Algorithm for DFT Computation, Overflow and Scaling, Bit-Reversed Index Generation & Implementation on the TMS32OC67XX. Text Book1 :7.3,7.4,7.5,7.6,8.2,8.3,8.4,8.5,8.6	9	**CO4**
4	**Embedded Signal Processing and Concepts:** Introduction to micro signal architecture, Overview of Blackfin Processor, Data arithmetic unit, address arithmetic unit, control unit, Bus Architecture and memory Text Book 3 : 5.1.1,5.1.2,5.1.3,5.1.4	9	**CO5**
5	**Applications of DSP Processors:** CODEC Interface Circuit. DSP Based Bio-telemetry Receiver, An Image Processing System, DTMF Detection using modified Goertzel algorithm Text Book 2 : 8.8,8.9,9.1,9.2,9.4 Reference Book 3: Chapter 1	9	**CO6**

Text Books:

1. "Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004.
2. "Digital Signal Processors-Architecture, Programming and Applications", Andhe Pallavi & K. Uma Rao, Sanguine Technical Publishers, 2012

Reference books:

1. "Digital Signal Processors", B Venkataramani and M Bhaskar TMH, 2nd, 2010.

2 "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2008.

3. Application report on: "Modified Goertzel algorithm in DTMF Detection using TMS320C80, Chiouguey J Chen, 1996.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE564	**DSP ALGORITHMS AND ARCHITECTURE**	
CO1	3	-
CO2	3	-
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	Tests	Assignments	Quizzes
Marks	**25**	**15**	**10**
Remember	30	10	10
Understand	10		5
Apply	10	5	
Analyze	10	5	
Evaluate			5
Create			

SEE- Semester End Examination (50 Marks)

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

MICROCONTROLLER

Course Code : 20ECE565 | **Credits : 03**
L: T: P: S : 3:0:0:0 | **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 function features of PIC microcontroller
CO2	Interpret the instruction sets of PIC 18 Microcontroller
CO3	Develop Assembly level codes for the controllers
CO4	Write the high level programs for PIC18 using Embedded C
CO5	Demonstrate the interfacing program using Embedded C
CO6	Apply the knowledge gained in PIC microcontroller in developing minor and major projects

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**PIC Microcontrollers: History, Features and Architecture** Microcontrollers and Embedded Processors, Overview of the PIC18 Family, PIC18 PIN connection, PIC18 Configuration Registers, WREG Register in PIC18, PIC18 File Register and access Bank, Use of Instructions with the Default Access Bank, PIC18 Status Register, PIC18 Data Format and Directives, Program Counter and Program ROM Space in the PIC18, RISC Architecture in the PIC18 Text-1: 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.8, 2.9, 8.1, 8.2	9	**CO1**
2	**Classification of Instructions and I/O Port Programming:** Arithmetic Instructions, Signed Number Concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate Instruction and Data Serialization, BCD and ASCII Conversion, Branch Instructions and Looping, Call Instructions and Stack, PIC18 Time Delay and Instruction Pipeline, I/O Port Programming in PIC18, I/O Bit Manipulation Programming Text-1: 3.1, 3.2, 3.3, 4.1, 4.2, 5.1, 5.2, 5.3, 5.4, 5.5	9	**CO2, CO3**
3	**PIC18 Programming in C:** Data Types and Time Delays in C, I/O Programming in C, Logic Operations in C, Data Serialization in C, Program ROM Allocation in C, Data RAM Allocation in C Text-1: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7	9	**CO2, CO3,CO4**
4	**PIC18 Programming in C: Timer, Serial Port and Interrupt** Programming Timers 0, 1, 2 and 3 in C, Counter Programming, Basics of Serial Communication, PIC18 connection to RS232, PIC18 Serial Port Programming in C, PIC18 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts Text 1: 9.1, 9.2, 9.3, 9.4, 10.2, 10.2, 10.4, 11.1, 11.2, 11.3	9	**CO2, CO3, CO4,CO5**
5	**PIC18 Interfacing :** LCD Interfacing, Keyboard Interfacing, ADC Characteristics, ADC Programming in the PIC18, DAC Interfacing, Sensor Interfacing and Signal Conditioning, Relays and Opto-isolators, Stepper Motor Interfacing, DC Motor interfacing and PWM Text-1: 12.1, 12.2, 13.1, 13.2, 13.3, 13.4, 17.1, 17.2, 17.3	9	**CO6**

TEXT BOOKS:

1. PIC Microcontroller And Embedded Systems, Mazidi M. A.,McKinley R. D., Causey D. Smith, Pearson Education International, 2008.

REFERENCE BOOKS:

1. PIC Microcontroller, Matic Nebojsa, Mikroelektronika, 1st edition 2008
2. PIC Microcontrollers , Verle Milan, Mikroelektronika, 1stEdition, 2009

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE565	**MICROCONTROLLER**	
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	2
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

ROUTING AND SWITCHING-01

Course Code : 20ECE566 **Credits : 3**
L: T: P: S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

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

CO1	Compare the network models and the protocols at each layer
CO2	Construct IP addressing table and perform subnetting in IPv4 and IPv6 network
CO3	Analyze the network to implement LAN security to mitigate threats and attack
CO4	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol
CO5	Examine the operation of Spanning tree protocols and Ether channel for network scalability
CO6	Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalable networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Networking Today:** Network Components, Protocols and Models:The Protocol Suites, Reference Models, Data Encapsulation, Data Link Layer: Purpose of the Data Link Layer, LAN Topologies, Ethernet Switching: Ethernet Frame, Ethernet MAC Address, The MAC Address Table , Network Layer: Network Layer, IPv4 Packet, IPv6 Packet, Router Routing Tables, MAC and IP,ARP, Transport Layer: Port Numbers, TCP Communication Process, UDP Communication, Application Layer: Application, Presentation, and Session **LAN Security Concepts:** Endpoint Security, Access Control,Layer 2 Security Threats,MAC Address Table Attack,LAN Attacks, Switch Security Configuration:Implement Port Security.	9	**CO1, CO3**
	1. **Basic Switch and End Device Configuration:**Cisco IOS Access, IOS Navigation, The Command Structure, Basic Device Configuration, Save Configurations, Configure IP Addressing, Verify Connectivity. 2. **SSH and Telnet Configuration** 3. **Switch port security Configuration**		
2	**IPv4 Addressing:**IPv4 Address Structure,IPv4 Unicast, Broadcast, and Multicast,Types of IPv4 Addresses,Network Segmentation,Subnet an IPv4 Network **IPv6 Addressing:** IPv6 Address Representation, IPv6 Address Types, GUA and LLA Static Configuration, Dynamic Addressing for IPv6 GUAs,Dynamic Addressing for IPv6 LLAs, Subnet an IPv6 Network	9	**CO2**
	1. **Basic Router Configuration :**Configure Initial Router Settings, Configure Interfaces, Configure the Default Gateway, Ping and Trace route Testing 2. **Subnetting Scenarios using IPv4 address** 3. **IPv4 address Configuration** 4. **IPv6 address Configuration**		
3	**VLAN :**Overview of VLANs, VLANs in a Multi-Switched Environment, VLAN Configuration, VLAN Trunks, Dynamic Trunking Protocol. **Inter-VLAN Routing:**Inter-VLAN Routing Operation, Router-on-a-Stick Inter-VLAN Routing.	9	**CO4**
	1. **VLAN Configuration** 2. **Dynamic Trunking Protocol Configuration** 3. **InterVLAN routing Configuration**		
4	**Spanning Tree Protocol :** Purpose of STP,STP Operations, Evolution of STP,RSTP,RSTP+, Portfast, BPDU Guard. **Ether Channel:** EtherChannel Operation, LACP, PAGP, Passive and Active mode in Etherchannel.	9	**CO5**
	1.Spanning Tree Protocol Configuration **2.Etherchannel Configuration**		

5	**DHCPv4:**DHCP4 ConceptsConfigure a Cisco IOS DHCP4 Server; Configure a DHCP4 Client, **SLAAC and DHCPv6:**IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6, Configure DHCPv6 Server.	**9**	**CO6**
	1. DHCPv4 Configuration **2. DHCPv6 Configuration**		

TEXT BOOKS:

1. CISCO Netacad (ONLINE ACCESS)
2. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016.

REFERENCE BOOKS:

1. Data Communications and Networking. Forouzan,5th Edition, McGraw Hill, Reprint-2017.

Mapping of CO v/s PSO:

COs	**PSO1**	**PSO2**
20ECE566	**ROUTING AND SWITCHING-01**	
CO1	3	3
CO2	-	-
CO3	3	-
CO4	3	-
CO5	3	3
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Tests**	**Assignments**	**Quizzes**
Marks	**25**	**15**	**10**
Remember			
Understand			5
Apply	20	10	5
Analyze	5	5	
Evaluate			
Create			

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**SEE Marks**
Remember	
Understand	
Apply	40
Analyze	10
Evaluate	-
Create	-

MICROPROCESSORS LAB

Course Code : 20ECL57 | **Credits : 1.5**
L: T: P: S : 0:0:1.5:0 | **CIE Marks : 25**
Exam Hours : 3 | **SEE Marks : 25**

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

CO1	Write assembly level programs using 8086 to perform arithmetic and logical operations
CO2	Apply the knowledge of computer number system to write code conversion programs in 8086
CO3	Develop assembly code for string operations, sorting of numbers and branch instructions of 8086
CO4	Demonstrate the I/O interfacing of 8086 with peripheral devices
CO5	Write 8051 assembly level programs to perform arithmetic and logical operations
CO6	Demonstrate the interfacing of 8051 with stepper motor, switches, LCD & LED modules

Mapping of Course Outcomes to Program Outcomes:

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

Sl.No.	LIST OF EXPERIMENTS	COs
1	Write an assembly level programs for basic arithmetic operations using 8086 (i) Signed and Unsigned Addition (ii) Subtraction (iii) Signed and Unsigned Multiplication (iv) Signed and Unsigned Division	CO1
2	Write an assembly level programs assembly level programs for basic logical operation using 8086 (i)To check number is positive or negative (ii)To count number of one's & zero's	CO1
3	Write an assembly Level programs for code conversion of 8086 (i) ASCII to binary; (ii) Decimal to Hex; (iii) ASCII to Decimal; (iv) Binary to BCD and vice versa	CO2
4	Write an assembly level programs for String operations using 8086 (i) Reverse the string (ii) To check whether the string is palindrome or not	CO3
5	Write an assembly level programs using 8086 for sorting operations like ascending, descending, largest and smallest in microprocessor	CO3
6	Interfacing of 8086 with (Assembly Level Programming) i) Stepper motor i) Seven segment Display ii) Logic controller (BCD up counter and Down counter) iii) Keyboard Display Interface	CO4
7	Write a assembly level program for basic arithmetic and logical operations in 8051 microcontroller.	CO5
8	Assembly Level Programming to illustrate the interfacing of stepper motor, switches, LCD & LED modules with the microcontroller 8051.	CO6

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECL57	MICROPROCESSORS LAB	
CO1	3	-
CO2	3	3
CO3	3	-
CO4	3	3
CO5	3	-
CO6	3	3

Assessment Pattern

Bloom's Taxonomy	Test	Conduction	Viva	Observation	Record
Marks	**25**	**10**	**5**	**5**	**5**
Remember	5	-	-	-	5
Understand	5	5	-	-	-
Apply	10	5	5		
Analyze	5			5	
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Performance (day to day)	Internal test
Marks	**15**	**10**
Remember	5	
Understand	5	
Apply	5	5
Analyze		5
Evaluate	-	-
Create	-	-

SEE- Semester End Examination (25 Marks)

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

CMOS VLSI DESIGN LAB

Course Code : 20ECL58 | **Credits : 1.5**
L: T: P: S : 0:0:1.5:0 | **CIE Marks : 25**
Exam Hours : 3 | **SEE Marks : 25**

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

CO1	Demonstrate the working of analog and digital CMOS circuits through SPICE simulation
CO2	Use the schematics of CMOS circuits to construct and verify their layouts
CO3	Employ the Switch level description of digital CMOS circuits for simulation using Verilog
CO4	Employ the Gate level description of digital CMOS circuits for simulation and synthesis
CO5	Operate the selected combinational and sequential circuits with the timing constraints
CO6	Compare the various amplifier circuits in terms of gain, bandwidth and phase response

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	3	3	-	-	3	3	3	3
CO2	3	3	3	3	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
CO5	3	3	3	3	3	3	1	-	3	3	3	3
CO6	3	3	3	3	3	3	1	-	3	3	3	3

Sl. No.	LIST OF EXPERIMENTS	COs
1	Draw the schematic of the following circuits for the given specifications, and verify using Transient and DC Analyses: i) CMOS Inverter, ii) Transmission gate	CO1
2	Draw the schematic of the following circuits for the given specifications, and verify using Transient and DC Analyses: i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate	CO1
3	Draw the layout of the following circuits and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) CMOS Inverter, ii) Transmission gate	CO2
4	Draw the layout of the following circuits and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) 2-input CMOS NAND gate, ii) 2-input CMOS NOR gate	CO2
5	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	CO3
6	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	CO3
7	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	CO4, CO5
8	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	CO5
9	Draw the schematic of the following amplifiers for the given specifications, and verify the same using Transient, DC and AC Analyses: i) Common Source amplifier, ii) Common Drain amplifier	CO1, CO6
10	Draw the layout of the following amplifiers and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) Common source, ii) Common Drain amplifier	CO2, CO6
11	Draw the schematic of the following amplifiers for the given specifications, and verify using Transient, DC and AC Analyses: i) Differential Amplifier, ii) Two-stage Op-amp	CO1, CO6
12	Draw the layout of the following amplifiers and perform physical verification using DRC, ERC and LVS. Extract RC and back-annotate the same and verify the Design: i) Differential Amplifier, ii) Two-stage Op-amp	CO2, CO6

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECL58	CMOS VLSI DESIGN LAB	
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	-
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Performance (day to day)	Internal test
Marks	**15**	**10**
Remember	5	-
Understand	5	5
Apply	5	5
Analyze	-	-
Evaluate	-	-
Create	-	-

SEE- Semester End Examination (25 Marks)

Bloom's Taxonomy	SEE Marks
Remember	5
Understand	10
Apply	10
Analyze	-
Evaluate	-
Create	-

MINI PROJECT-III			
Course Code	**20ECL59B**	**Credits**	**:02**
L: T: P: S	**0:0:2:0**	**CIE Marks**	**:50**
Exam Hours	**03**	**SEE Marks**	**:50**

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

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

CIE - Continuous Internal Evaluation (25)

Bloom's Taxonomy	Mini Project-III
Marks (Out of 25)	-
Remember	-
Understand	-
Apply	10
Analyze	5
Evaluate	5
Create	5

SEE – Semester End Examination (25)

Bloom's Taxonomy	Mini Project-III
Remember	-
Understand	-
Apply	10
Analyze	5
Evaluate	5
Create	5

SIXTH SEMESTER

(SYLLABUS)

DIGITAL COMMUNICATION

Course Code : 20ECE61 | **Credits : 3**
L: T: P: 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 be able 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	Estimate the signal in presence of noise by appropriate receiver design
CO5	Identify digital modulation techniques for radio and satellite communication
CO6	Compare the spread spectrum techniques available for secured communication

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Introduction to Digital Communication and waveform coding techniques:** Basic signal processing operations in digital communications, Sampling Theorem, Quadrature sampling of band pass signals, Reconstruction of a message process from its samples, practical aspects of sampling and signal recovery, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse code modulation, quantization noise and Signal-to-noise ratio, Robust quantization, Differential PCM, Delta modulation, Applications.	9	**CO1**

	Text-1: 1.2,4.1,4.2,4.3,4.4,4.5,4.6,4.7,5.1,5.3,5.4,5.5,5.6,5.8		
2	**Baseband 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), Inter symbol interference, Nyquist's criterion for distortion less base-band binary transmission, eye pattern, Adaptive Equalization for data transmission. Text-6.1, 6.2,6.3,6.4,6.6,6.8	9	**CO1,CO2**
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, Comparison of Binary and Quaternary Modulation techniques, M-ary Modulation Techniques-M-ary PSK, M-ary QAM, Power spectra , Bandwidth efficiency Text-1: 7.1,7.2,7.3,7.4,7.5,7.6,7.7,7.8	9	**CO3, CO5**
4	**Detection and Estimation**: Model of Digital Communication System, Gram-Schmidt Orthogonalization procedure, geometric interpretation of signals, response of bank of correlators to noisy input, Detection of known signals in noise, correlation receiver, matched filter receiver, estimation- concepts and criteria, Maximum Likelihood Estimation Text-1: 3.1, 3.2,3.3,3.4,3.5,3.7,3.8,3.10,3.11	9	**CO4**
5	**Spread Spectrum Techniques:** Pseudonoise sequences, A notion of Spread Spectrum, Direct Sequence Spread coherent BPSK , Signal space dimensionality and Processing Gain ,Probability of Error, Frequency- Hop Spread Spectrum, Applications Text-9.1,9.2,9.3,9.4,9.5,9.6,9.7	9	**CO6**

Textbooks:

1. Digital Communications, Simon Haykin, WILEY INDIA Edition, Reprint 2011.

References:

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.
3. Electronic communication systems, Kennedy and Davis, 5th edition, 2011, TMH.
4. Modern digital and analog Communication systems, B. P. Lathi, 3rd edition, 2015, Oxford University Press.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE61	DIGITAL COMMUNICATION	
CO1	-	-
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

EMBEDDED SYSTEM DESIGN

Course Code	**: 20ECE62**	**Credits**	**: 03**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

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

CO1	Apply the features of processors, Memory, I/O and communication interfaces in developing embedded system
CO2	Use software development tools to design embedded systems
CO3	Appraise the programmers model of Cortex M processors to give frugal solutions for real world problems
CO4	Design computational models for hardware and software design
CO5	Apply the concept of RTOS in embedded system applications
CO6	Engage in self learning in analyzing and carry out embedded projects

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Contents of Module	Hrs	COs
1	**Introduction to Embedded Systems**: What is an Embedded Syster Embedded Systems Vs General Computing Systems, Classification o Embedded System, Major Application areas of Embedded System, Purpose o Embedded System, The Innovative Bonding of lifestyle with Embedde Technologies Text-1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 **Typical Embedded System** : Core of the Embedded System, Sensors ar Actuators, Memory, Communication Interface, Embedded Firmware Text-1: 2.1, 2.2, 2.3.1, 2.3.2, 2.4, 2.4.1, 2.4.2, 2.5	**9**	**CO1**
2	**Introduction to ARM Cortex M Processors**: What are ARM Cortex M Processors, Features of Cortex M3 and M4, Advantages and Applications of Cortex M Processors. Text 2: 1.1, 1.2, 3.2, 1.3 **Introduction to Embedded Software Development**: Software Development flow, Compiling the applications, software flow, Microcontroller interfaces Text 2: 2.3, 2.4, 2.5, 2.8	**9**	**CO2, CO3, CO6**
3	**ARM- 32 bit Microcontroller family**: Cortex M4 Basics Architecture of ARM Cortex-M4, Block diagram of ARM Cortex-M4, Operation modes and states, Registers, Special Registers, Data type, Memory System, Exceptions and interrupts ,Debug, Instruction Set Summary Text -2: 4.1, 3.1.4, 4.2, 4.4, 4.5 , 4.7, 5.6.1-5.6.15, 5.7.5	**9**	**CO3, CO2, CO6**
4	**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 Text 1: 7.1, 7.2, 7.3, 7.4	**9**	**CO4, C06**
5	Real Time Operating System(RTOS) based Embedded System Design Operating system basics, Types of operating systems, Tasks, Process and threads, Multiprocessing and Multitasking, Task Scheduling Text-1: 10.1, 10.2, 10.3, 10.4, 10.5 The embedded product development lifecycle Text-1: 15.1-15.4	**9**	**CO5, CO6**

TEXT BOOKS:

1. Introduction to Embedded Systems, Shibu K V,2nd Edition 2017, McGRAW HILL
2. The Definitive Guide to ARM Cortex –M3 and Cortex-M4 Processors Joseph Yiu, 3rd Edition, 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.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE62	EMBEDDED SYSTEM DESIGN	
CO1	-	2
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	SEE Mark
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	-
Create	-

MICROELECTRONIC CIRCUITS

Course Code	**: 20ECE63**	**Credits**	**: 03**
L: T: P: S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able 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 amplifier circuits to achieve the target specifications

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Biasing in MOS amplifier circuits**: Biasing by fixing V_{GS}, Biasing by fixing V_G 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, Numerical Examples **MOSFET as an Amplifier and Switch:** Graphical derivation of the transfer characteristics, operation as switch, operation as linear amplifier. Text-1: 4.3, 4.4, 4.5	9	**CO1**
2	**Small-Signal Operation and Models of MOSFET:** DC bias point, Signal current in the drain terminal, Voltage gain, Separating DC analysis and signal analysis, Small signal equivalent circuit models, Transconductance , Equations for g_m, T equivalent circuit model, Modeling the body effect **Single stage MOS amplifiers:** CS amplifier, CS amplifier with a source resistance, Common gate amplifier, Common drain or source follower amplifier, Numerical Examples Text-1: 4.6, 4.7	**9**	**CO2, CO3**
3	**High- Frequency Response- General Consideration**: High frequency gain function, Exact and approximate determination of 3-dB frequency f_H, High frequency response of CS, CG and CD amplifiers with active loads (analysis and numerical for determining f_H only required) **Cascode Amplifier:** MOS cascode, Frequency response of MOS cascode, Cascode current source, Double cascoding, Folded cascade, BiCMOS cascode. Text-1: 6.4, 6.5, 6.7, 6.8, 6.10	**9**	**CO2, CO3, CO4**
4	**IC biasing:** Basic MOSFET current source, MOS current steering circuits. **Current mirror circuits with improved performance:** Simple MOS current mirror, Simple Current Mirror with Beta Helper, Cascode Current Mirror, Wilson Current Mirror Text 1: 6.3 Text 2: 4.2	**9**	**CO5**
5	**Differential Amplifiers:** MOS differential pair, Operation with common mode and differential input voltage, Differential gain and effect of r_o, CMRR, Effect of R_D mismatch and g_m mismatch on CMRR **Differential amplifier with active load:** Differential-to- single ended conversion, Active loaded MOS differential pair, differential gain of the active loaded MOS pair, Common mode gain and CMRR of active loaded MOS pair Text-1: 8.1, 8.2, 8.5	**9**	**CO6**

TEXT BOOKS:

1. Microelectronic circuits- Theory and applications, Adel S. Sedra and Kenneth C. Smith, 5th edition, 2015.

2. Analysis and Design of Analog Integrated Circuits, Paul R. Gray, Paul J Hurst, Stephen H Lewis and Robert Gamier , Oxford International version, John Wiley, 5th Edition, 2009.

REFERENCE BOOKS:

1. Microelectronics-Analysis and Design, Sundaram Natarajan, 2007, Tata McGraw-Hill
2. Fundamentals of Microelectronics, Behzad Razavi, 2008, John Wiley India Pvt. Ltd.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE63	**MICROELECTRONIC CIRCUITS**	
CO1	-	2
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

MICROWAVES & RADAR

Course Code : 20ECE641 **Credits : 03**
L: T: P: S : 3:0:0:0 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

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

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

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**MICROWAVE SOURCES** :Introduction, Microwave frequencies, Microwave systems, Radiation hazards, Generation of microwaves- Reflex Klystron, TWT, Magnetron, Microwave active devices: IMPATT, TRAPATT and Gunn diodes. Text-1: 9.2,9.3,9.5 Text-2: 0.1,0.3,7.1,8.2,8.3,9.4	9	CO1,CO2
2	**MICROWAVE 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 (Single Stub). Text-2:3.1,3.2,3.3,3.4,3.5,3.6	9	CO3
3	**MICROWAVE NETWORK THEORY:** Introduction, S matrix representation of multiport 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. Text-1:6.1,6.2,6.3	9	CO4
4	**MICROWAVE PASSIVE DEVICES:** Attenuators, Phase shifters, Waveguide Tees, Magic tees, circulators and isolators, directional couplers-Bethe-hole coupler. Text-1:6.4.14,6.4.15,6.4.16,6.4.17,6.4.18.	9	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. Text-1.6,3:1.2,1.3,1.4,3.1,3.2,4.1,4.2,4.5,4.7,4.10	9	CO6

TEXT BOOKS:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd , 2010.
2. Microwave Devices and circuits- Liao, Pearson Education
3. Introduction to Radar Systems, Merrill Skolnik,3rd Edition ,2001,TMH

REFERENCE BOOKS:

1. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd. 3rdEdn, 2008.
2. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn, 2015.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE641	**MICROWAVES & RADAR**	
CO1	-	3
CO2	-	3
CO3	3	-
CO4	3	3
CO5	3	-
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

NANOELECTRONICS

Course Code	**:**	**20ECE642**	**Credits**	**:**	**3**
L: T: P: S	**:**	**3 : 0 : 0 :0**	**CIE Marks**	**:**	**50**
Exam Hours	**:**	**3 hours**	**SEE Marks**	**:**	**50**

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

CO1	Know the basic engineering science and technical knowledge of Nanoelectronics
CO2	Understand the underlying principles of Quantum Mechanics and its role in Nano electronic devices
CO3	Appraise the electromechanical properties of Nano structures
CO4	Analyze the aspects of nanotechnology and processes involved in fabricating Nano devices
CO5	Identify the nature of Carbon bond and the various Nano structures of Carbon
CO6	Leverage the understanding of technologies used modern day electronic devices, such as sensors

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	Introduction to Nano electronics, Fabrication methods: Top-down approach, Bottom-up approach process methods for understanding the growth of nano materials. Basics of Quantum Mechanics, Electronic properties of atoms and solids, Time-independent Schrodinger's equation, Density of States, Free Electron Theory, Electrons confined to potential wells, Basic introduction to crystalline lattices, Band theory of solids, Kronig-Penney model of Band structure. Text 1: 1.1, 1.4	9	**CO1, CO2**
2	Characterization: Microscopy techniques – Transmission Electron Microscopy, Field Ion Microscopy, Scanning Microscopy. Diffraction techniques – Bulk and Surface diffraction techniques. Semiconductor Nanostructures: Revisiting Semiconductor Physics, Models of Quantum Wells, Wires, and Dots – Size and Dimensionality effects, Quantum confinement in 1-D, 2-D and 3-D, Electronic Density of States. Text 1: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.3, 3.4	9	**CO2, CO3**
3	Fabrication techniques: Requirements, Growth of Quantum wells, Lithography and Etching, Cleaved-Edge Over Growth, Growth of Vicinal Substrates, Strain Induced Dots and Wires, Electrostatically Induced Dots and Wires, Quantum Well Width Fluctuations, Thermally Annealed Quantum Wells, Semiconductor Nanocrystals, Colloidal Quantum Dots, Self-Assembly Techniques. Physical Processes in Semiconductor Nanostructures: Modulation Doping, Quantum Hall Effect, Resonant Tunneling, Charging Effects, Ballistic Carrier Transport, Inter-band Absorption, Intra-band Absorption, Light Emission Processes, Phonon Bottleneck, Quantum Confined Stark Effect, Nonlinear Effects, Coherence and Dephasing, Characterization of Semiconductor Nanostructures: Optical Electrical and Structural. Text 1: 3.5, 3.6, 3.7	9	**CO2, CO4**
-4	Carbon Nanostructures: Carbon molecules – Nature of Carbon bond, Carbon structures. Carbon clusters – Structure and electronic conductivity	9	**CO4, CO5**

	of Fullerenes (C60), other Buckyballs. Carbon Nanotubes – Fabrication, Structure, Electrical, Vibrational, Mechanical, and Transport properties. Application of Carbon Nanotubes. Text 3: 3.1, 3.2, 3.9, 4.1, 4.2, 4.5, 4.6, 4.7,4.8, 4.9		
5	Nanoelectronics with Tunneling Devices: Tunneling through a Potential Barrier, Coulomb Blockade in Single Electron Transistors (SET), SET Circuit Design – Wiring and Drivers, Logic and Memory Circuits. Nanosensors: What is a Sensor?, Nanoscale organization for Sensors, Characterization, Sensors based on Optical Properties, Electrochemical sensors, Sensors based on Physical Properties, Nanobiosensors, Smart Dust. A brief introduction to Nanomedicines in Diagnostic and Therapeutic applications. Text 2: 13.1, 13.2 Text 3: 12, 13.1, 13.2, 13.3	9	**CO6**

TEXT BOOKS:

1. Nanoscale Science and Technology, Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, John Wiley, 2007.
2. Nanoelectronics & Nano systems: From Transistor to Molecular & Quantum Devices, Karl Goser, Jan Dienstuhl, Peter Glösekötter, Springer, 2004.
3. Nano: The Essentials - Understanding Nanoscience and Nanotechnology, T Pradeep, Tata McGraw Hill, 2007.

REFERENCE BOOKS:

1. Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), W. Ranier, Wiley-VCH, 2003
2. Fundamentals of Nanoelectronics, G.W. Hanson, Pearson, 2009
3. Introduction to Nanotechnology, C.P. Poole, F. J. Owens, Wiley, 2003
4. Nano systems, K.E. Drexler, Wiley, 1992.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE642	**NANOELECTRONICS**	
CO1	-	3
CO2	-	3
CO3	3	-
CO4	3	-
CO5	3	-
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	SEE Marks
Remember	20
Understand	30
Apply	10
Analyze	-
Evaluate	-
Create	-

DIGITAL SWITCHING SYSTEMS

Course Code : 20ECE643 | **Credits : 03**
L: T: P: 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 be able to:

CO1	Recall the fundamental concepts of telecommunications
CO2	Describe the evolutions of switching systems
CO3	Demonstrate the knowledge of digital switching system and its model
CO4	Model the telecommunications traffic measurement
CO5	Examine the methods of grading and Time Division switching
CO6	Apply the knowledge for the design and maintenance of switching system software

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**DEVELOPMENT 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. **EVOLUTION OF SWITCHING SYSTEMS:** Introduction, Message switching, Circuit switching, Functions of switching systems, Distribution systems, Basics of crossbar systems, Electronic switching. *Text-1, Chapter 1,2 &3*	9	**CO1** **CO2**
2	**DIGITAL SWITCHING SYSTEMS**: Switching system hierarchy, Evolution of digital switching systems, Stored program control switching systems, Building blocks of a digital switching system, Basic call processing. **SWITCHING COMMUNICATION AND CONTROL:** Levels of control, basic functionalities of digital switch subsystems, control architectures, multiplexed highways, switching fabric, programmable junctors, network redundancy. *Text-2, Chapter 1 & 2*	9	**CO3**
3	**TELECOMMUNICATIONS TRAFFIC:** Introduction, Unit of traffic, Congestion, Traffic measurement, Mathematical model, lost call systems, Queuing systems. *Text-1, Chapter 4*	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, Synchronisation. *Text-1, Chapter 5 & 6*	9	**CO5**
5	**SWITCHING SYSTEM SOFTWARE:** Introduction, Basic software architecture, Software architecture for level 1 to 3 control, Digital switching system software classification, Call models, Software linkages during call, Feature flow diagram, Feature interaction. **A methodology for assessing switching software quality** *Text-2, Chapter 5 & 6*	9	**CO6**

TEXT BOOKS:

1. Telecommunication and Switching, Traffic and Networks - J E Flood: Pearson Education, 2002.
2. Digital Switching Systems, Syed R. Ali, TMH Ed 2002.

REFERENCE BOOKS:

1. Digital Telephony - John C Bellamy: Wiley India Pvt. Ltd, 3rd Ed, 2008.
2. Telecommunication Switching Systems and Networks – Thiagarajan Vishwanathan /PHI

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE643	**DIGITAL SWITCHING SYSTEMS**	
CO1	-	3
CO2	-	3
CO3	3	-
CO4	3	3
CO5	3	-
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

AUTOMOTIVE ELECTRONICS

Course Code	**: 20ECE644**	**Credits**	**: 3**
L: T: P: S	**: 3 : 0 : 0 :0**	**CIE Marks**	**: 50**
Exam Hours	**: 3 hours**	**SEE Marks**	**: 50**

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

CO1	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.
CO2	Comprehend dashboard electronics and engine system electronics
CO3	Identify various physical parameters that are to be sensed and monitored for maintaining the stability of the vehicle under dynamic conditions.
CO4	Implement the controls and actuator system pertaining to the comfort and safety of commuters.
CO5	Analyze the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems.
CO6	Gain insight about building future automotive subsystems that contributes to the safety and health of the society

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Automotive Fundamentals, the Systems Approach to Control and Instrumentation**: Use of Electronics in the Automobile, Antilock Brake Systems(ABS), Electronic steering control, Power steering, Traction control, Electronically controlled suspension Text 1: Chapters 1, 2	9	**CO1, CO2**
2	**Automotive instrumentation Control**: Operational amplifiers, Digital circuits, Logic circuits, Microcomputer fundamentals, Microcomputer operations, Microprocessor architecture, digital to analog converter, analog to digital converter, Microcomputer applications in automotive systems, Instrumentation applications of microcomputers, Microcomputer in control systems Text 1: Chapters 3, 4	8	**CO2**
3	**The basics of Electronic Engine control**: Integrated body: Climate controls, Motivation for Electronic Engine Control, Concept of an Electronic Engine Control System, Definition of General Terms, Definition of Engine Performance Terms, Electronic fuel control system, Engine control sequence, Electronic Ignition, Sensors and Actuators, Their applications, air flow rate sensor, Indirect measurement of mass air flow, Engine crankshaft angular position sensor, Automotive engine control actuators, Digital engine control, Engine speed sensor, Timing sensor for ignition and fuel delivery, Electronic ignition control systems, Safety systems, Interior safety, Lighting, Entertainment systems Text 1: Chapters 5, 6	10	**CO3, CO4**
4	**Vehicle Motion Control and Automotive diagnostics**: Cruise control system, Digital cruise control, Timing light, Engine analyzer, On-board and off-board diagnostics, Expert systems. Stepper motor-based actuator, Cruise control electronics, Vacuum - antilock braking system, Electronic suspension system, Electronic steering control, Computer-based instrumentation system, Sampling and Input\output signal conversion, Fuel quantity measurement, Coolant temperature measurement, Oil pressure measurement, Vehicle speed measurement, Display devices, Trip-Information-Computer, Occupant protection systems Text 1: Chapters 8, 10	9	**CO4, CO5**
5	**Future automotive electronic systems:** Alternative Fuel Engines, Collision Wide Range Air/Fuel Sensor, Alternative Engine, Low Tire Pressure Warning System, Collision avoidance Radar Warning Systems, Low Tire Pressure Warning System, Radio Navigation, Advance Driver Information System. Alternative-Fuel Engines, Transmission Control, Collision Avoidance Radar Warning System, Low Tire Pressure Warning System, Speech Synthesis Multiplexing in Automobiles, Control Signal Multiplexing, Navigation Sensors, Radio Navigation, Signpost Navigation, Dead Reckoning Navigation Future Technology, Voice Recognition Cell Phone Dialling Advanced Driver information System, Automatic Driving Control. Text 1: Chapter 11	9	**CO6**

TEXT BOOKS:

1. Understanding Automotive Electronics‖, William B Ribbens, 6th Edition, Elsevier Publishing, 1997.

REFERENCE BOOKS:

1. Robert Bosch GMBH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc.,

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE644	AUTOMOTIVE ELECTRONICS	
CO1	-	3
CO2	-	3
CO3	3	-
CO4	3	3
CO5	3	-
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**SEE Marks**
Remember	20
Understand	30
Apply	10
Analyze	-
Evaluate	-
Create	-

IOT AND WIRELESS SENSOR NETWORKS

Course Code : 20ECE645 | **Credits : 3**
L: T: P: 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 be able to:

CO1	Illustrate the architecture and design principles of IoT and WSN networks
CO2	Compare IoT & M2M communication protocols
CO3	Identify different data collection and storage methods using cloud model
CO4	Classify the Communication Protocols for WSN network at different layers
CO5	Identify the tools and software platforms for WSN and IoT networks
CO6	Develop an IoT and WSN application and engage in lifelong learning by assessing the network performance

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Overview of Internet of Things:** IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Examples of IoT. IoT/M2M Systems, Layers and design standards, Data Enrichment, Data management and consolidation gateway and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAP-MQ, MQTT,XMPP) for IoT/M2M devices. **Text**-1: **1.1,1.2,1.3,1.4,1.5,1.6,1.7,2.2,2.4,3.2,3.3.2, 3.3.3**	**9**	**CO1,CO2, CO6**
2	**Design Principles for IoT:** Internet connectivity, Internet-based communication, IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS,FTP,TELNET and ports. **Data Collection, Storage and Computing using a Cloud Platform:** Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits. **Text-1: 4.2, 4.3, 4.3.1,4.3.2, 4.4, 4.6, 6.2, 6.3, 6.4.2**	**9**	**CO2, CO3, CO6**
3	**Overview of Wireless Sensor Networks:** Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. **Architectures**: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. **Text-2 – 1.4, 1.6, 2.1,2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5**	**9**	**CO1**
4	**Wireless Sensor Network Protocols:** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols(CSMA,PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-	**9**	**CO4, CO6**

	Efficient Multipath unicast Routing, Geographic Routing-Basics of position based routing, geocasting. **Text-2: 4.3, 5.1.3, 5.2.2, 5.2.3, 5.2.4, 5.3.1, 5.3.2, 5.4.1,5.4.2, 5.4.3, 7.2, 7.3, 11.3.4, 11.5.1, 11.5.2**		
5	**Prototyping and Designing Software for IoT Applications:** Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. **Sensor Network Platform and Tools:** Sensor Node Hardware, Sensor Network Programming Challenges, Node Level Software Platforms. **Text-1:9.1,9.2.1,9.2.2, 9.3** **Text-3: 7.1,7.2,7.3**	**9**	**CO5, CO6**

TEXT BOOKS:

1. Raj Kamal, ‖Internet of Things-Architecture and design principles, McGraw Hill education.
2. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
3. Feng Zhao & Leonidas J. Guibas, —Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS:

1. Anna Hac, —Wireless Sensor Network Designs‖, John Wiley, 2003.
2. Kazem Sohraby, Daniel Minoli, &TaiebZnati, —Wireless Sensor Networks- Technology, Protocols, And Applications‖, John Wiley, 2007.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE645	**IOT AND WIRELESS SENSOR NETWORK**	
CO1	3	2
CO2	3	-
CO3	3	2
CO4	3	-
CO5	3	2
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

MULTIMEDIA COMMUNICATION

Course Code : 20ECE646 | **Credits : 3**
L: T: P: 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 be able to:

CO1	Develop the basics of multimedia communication
CO2	Identify various media types to represent them in digital form
CO3	Apply distinct compression techniques to compress text and images .
CO4	Apply different types of compression techniques to compress audio and video
CO5	Analyze the varied features of Distributed Multimedia systems
CO6	Examine the knowledge about multimedia communication across different networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	Cos
1	**Multimedia Communications**: Introduction, Human Communication Model, Evolution, Technology Framework: Multimedia technologies, Multimedia networking and Multimedia conferencing, technologies for e-content, Challenges involved with multimedia communication Text 2: 2.1, 2.2, 2.3, 2.4	9	**CO1**
2	**Information Representation**: Multimedia information representation: Introduction, Digitization Principles, Representation of Text, Images, Audio & Video; Multimedia applications: Media composition, Media communication, Media entertainment Text 1: 2.1 to 2.7	9	**CO2**
3	**Text and image compression:** Introduction, Compression principles, text compression, image Compression standards, Still Image Compression standards: JBIG and JPEG, JPEG-2000 Architecture and Features. Text 1: 3.1 to 3.5 Text 2: 2.5.5	9	**CO3**
4	**Audio and video compression:** Introduction to Audio compression, MPEG audio coders, Dolby audio coders Video Compression: Basic principles, Video compression standards: MPEG-1, MPEG-2, MPEG-4 standards, H.261, H.263 and H.264 standards. Text 1: 4.1 to 4.4 Text 2: 5.3.2,	9	**CO4**
5	**Distributed multimedia systems:** Introduction, main Features of a DMS, Resource management of DMS, Networking, Multimedia operating systems. Multimedia Transport across ATM Networks Text 2: 4.1 to 4.5, 6.3.10	9	**CO5, CO6**

TEXT BOOKS:

1. Multimedia Communication, Fred Halsall, Pearson education, 2011
2.Multimedia Communication System, K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Pearson education, 2004.

REFERENCE BOOKS:

1. Multimedia: Computing, Communications & Application, R. Stein Metz and K. Nahrstedt, Pearson Education, Inc, 2012
2. Multimedia Systems: John F Koegel Buford, Pearson India, 2013 Edition

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE646	**MULTIMEDIA COMMUNICATION**	
CO1	3	-
CO2	3	2
CO3	3	-
CO4	3	-
CO5	3	2
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	SEE Marks
Remember	-
Understand	15
Apply	20
Analyze	15
Evaluate	-
Create	-

REAL TIME OPERATING SYSTEMS

Course Code : 20ECE651 | **Credits : 03**
L:T:P:S : 3:0:0:0 | **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 functions of real-time operating systems
CO2	Analyze the concepts of Real Time operating Systems
CO3	Choose the Real time operating system requirements for design issues
CO4	Analyze the design parameters and program structure of RTOS
CO5	Appraise interaction between multiple tasks in exploiting concurrency
CO6	Evaluate common design problems for frugal solutions

Mapping of Course Outcomes to Program Outcomes:

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

Module no	Contents of Module	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. (Text book 1: 1.1,1.4 to 1.9; Text book 2: 1.2) 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. (Text book 2: 4.1 to 4.7, 5.2 to 5.6)	9	**CO1, CO2, CO3**
3	**Real Time Kernel Objects**- Semaphores: Defining Semaphores, Typical, Operations, Typical Semaphore Use. Message queues: Defining Message Queues, Message Queue States, Message Queue Content, Message Queue Storage, Typical Message Queue Operations, Typical Message Queue Use. (Text book 2: 6.2 to 6.4, 7.2 to 7.7)	9	**CO4, CO5**
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 (Text book 2: 12.1 to 12.3,13.1 to 13.5)	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 (Text book 2: 15.2 to 15.4,15.6,16.2 to 16.4)	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.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE651	**REAL TIME OPERATING SYSTEMS**	
CO1	3	3
CO2	3	-
CO3	3	3
CO4	3	-
CO5	3	3
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (50Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	25	15	10
Remember	5	-	-
Understand	5	-	5
Apply	5	7.5	-
Analyze	5	-	-
Evaluate	5	-	5
Create	-	7.5	-

SEE- Semester End Examination (50Marks)

Bloom's Category	SEE Marks
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	-

ANALOG AND MIXED MODE VLSI DESIGN

Course Code	**: 20ECE652**	**Credits**	**: 04**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the Student will be able 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 challenges associated with 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	Analyze various non-linear analog circuits

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs	COs
1	Data converter fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Digital Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues. **T1, Ch28**	9	CO1
2	Data Converter Architectures: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC. **T1: Ch29**	9	CO2
3	ADC Architectures, Flash ADC, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **T1: Ch29**	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. **T2: Ch33**	9	CO3, CO4, CO5
5	Non-Linear Analog Circuits: Basic CMOS Comparator Design, Analog Multipliers, Multiplying Quad, Level Shifting. **T1: Ch26**	9	CO6

TEXT BOOKS:

1. Design, Layout, Simulation, R. Jacob Baker, Harry W Li, David E Boyce, PHI Education, 2003.

2. CMOS - Mixed Signal Circuit Design, R. Jacob Baker, John Wiley India Pvt. Ltd, 2008.

REFERENCE BOOKS:

1. Design of Analog CMOS Integrated Circuits, B Razavi, First Edition, McGraw Hill, 2001.

2. CMOS Analog Circuit Design, P E Allen and D R Holberg, 2nd Edition, Oxford University Press, 2002.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE652	**ANALOG AND MIXED MODE VLSI DESIGN**	
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes	Self Study
Marks (out of 50)	25	10	10	10
Remember	5	-	5	-
Understand	10	5	-	5
Apply	10	-	5	-
Analyze	-	5	-	-
Evaluate	-	-	-	5
Create	-	-	-	-

SEE- Semester End Examination (50 Marks)

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

COMPUTER COMMUNICATION NETWORKS

Course Code : 20ECE653 | **Credits : 3**
L: T: P: 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 be able to:

CO1	Identify the basic network characteristics and models
CO2	Classify the addressing schemes at different layers
CO3	Compare the standards associated with Ethernet protocol
CO4	Illustrate the Wireless LAN characteristics and its architecture
CO5	Analyze the routing of packets and the path cost using different routing algorithms
CO6	Examine the protocols and functions associated with various layers and their use in scaling networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Introduction:** Data Communications: Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, Internet. **Network Models:** TCP/IP Protocol Suite, The OSI Model. **Data-Link Layer:** Introduction: Nodes and Links, Services, Categories of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. **Text-1: 1.1,1.2,1.3,1.4,2.2,2.3,9.1,9.2,11.1,11.2**	9	CO1, CO2, CO6
2	**Media Access Control:** Random Access, Controlled Access. **Wired LANs: Ethernet:** Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, Implementation, Fast Ethernet: Access Method, Physical Layer, Gigabit Ethernet: MAC Sublayer, Physical Layer, 10 Gigabit Ethernet. **Text-1: 12.1,12.2,13.1,13.2,13.3,13.4,13.5**	9	CO3, CO6
3	**Wireless LANs:** Introduction: Architectural Comparison, Characteristics, Access Control, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Layers. **Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution (NAT). **Next Generation IP:** IPv6 Addressing **Text-1: 15.1,15.2,15.3,18.1,18.2,18.4, 22.1**	9	CO2, CO4, CO6
4	**Network Layer Protocols:** Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams, ICMPv4: Messages, Debugging Tools, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP. **Unicast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. **Text-1: 19.1,19.2,19.3,20.1,20.2**	9	CO5, CO6
5	**Transport Layer:** Introduction-Services**,** User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. **Application layer:** The Web and Hyper Text Transfer Protocol, File transfer, Electronic Mail- Architecture, Domain name system- Name Space, DNS in the Internet. **Text-1: 24.1.1,24.2,24.3,26.1,26.2,26.3.1,26.6.1,26.6.2**	9	CO6

TEXT BOOKS:

1. Data Communications and Networking, Forouzan, 5th Edition, McGraw Hill, Reprint-2017.

REFERENCE BOOKS:

1. Computer Networks, James J Kurose, Keith W Ross, Pearson Education, 2013.
2. Introduction to Data Communication and Networking, WayarlesTomasi, Pearson Education, 2007.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE653	**COMPUTER COMMUNICATION NETWORKS**	
CO1	3	-
CO2	3	2
CO3	3	-
CO4	3	-
CO5	3	-
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

IMAGE PROCESSING

Course Code	**: 20ECE654**	**Credits**	**: 3**
L: T: P: 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 be able to:

CO1	Identify the steps involved in processing digital images
CO2	Use transforms for processing images to reduce complexity
CO3	Choose appropriate image processing techniques for real time applications
CO4	Categorize spatial and frequency domain image enhancement techniques
CO5	Develop image processing algorithms for computer vision applications
CO6	Appraise filtering and image restoration techniques

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Introduction to Image Processing**: Introduction, Origins of DIP, Fundamental steps in DIP, Components of DIP system, Elements of visual perception, Image Sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and nonlinear operators, Arithmetic and Logical operations on images. Text-1: 1.1,1.2,1.4,1.5,2.1,2.3,2.4,2.5,2.6.2,2.6.3,2.6.4	9	**CO1**
2	**Image Transforms:** Introduction, Two dimensional Orthogonal and unitary Transforms, Properties of Unitary Transforms, 1D-DFT, 2D-DFT, DCT, Hadamard transforms. Text-2: 5.1,5.2,5.3,5.4,5.5,5.6,5.8	9	**CO1, CO2**
3	**Image Enhancement:** Image Enhancement in Spatial Domain- Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Gray level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram Matching, Spatial filters-Smoothing filters, Order statistics filter, Sharpening filters Frequency domain filters: smoothing andsharpeningfilters, Homomorphic filtering. Text-1: 3.1,3.2,3.2.1,3.2.2,3.2.3,3.2.4,3.3,3.3.1,3.3.2,3.4.1,3.5.1,3.5.2,3.6,4.8,4.9	9	**CO1, CO2, CO3, 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, position invariant degradations, estimation of the degradation function, inverse filtering, MMSE (Wiener) Filtering. Text-1: 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	9	**CO1, CO3, CO6**
5	**IMAGE ANALYSIS AND COMPUTER VISION:** Introduction, special feature extraction, edge detection, image segmentation, classification techniques Text-2: 9.1,9.2,9.4,9.13,9.14	9	**CO1, CO3, CO5**

Textbooks:

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

References:

1. B. Chanda and D.Majumdar, “Digital Image Processing and Analysis”, 1st Edition, PHI Learning Private Limited, 2014.
2. S.Jayaraman, S.Esakkirajan, T.Veerakumar, ”Digital Image Processing” Tata McGraw Hill, 2014.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE654	IMAGE PROCESSING	
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	-
CO5	3	2
CO6	3	-

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

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

PROGRAMMING WITH DATA STRUCTURES AND OOP

Course Code : 20ECE655 | **Credits : 3**
L: T: P: 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 be able to:

CO1	Use basic data structures like stacks and queues to solve real time problems efficiently
CO2	Usage of linked lists, objects, classes, constructors and destructors to reduce the complexity in programming
CO3	Identify the operator to be overloaded to redefine the way they work for user-defined data types
CO4	Examine when exceptions are called and apply the exception mechanisms
CO5	Distinguish between the inheritance types and apply them in real time applications
CO6	Build projects to investigate and resolve real time problems using data structures, linked lists and OOP concepts

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Introduction:** Arrays and Pointers Revisited, Dynamic memory allocation, Introduction to data structures, Stack and queues, Simple and circular queues, Application of stack and queues. Text 1: 3.1,3.2,3.3, 3.4 Text 2: 8.1, 8.2, 8.4, 8.5	9	**CO1**
2	**Linked Lists:** Simple linked list|, operations- Creation, insertion, deletion, searching. Doubly linked list, operations- Creation, insertion, deletion, searching. Circular linked list, operations- Creation, insertion, deletion, searching, Applications of linked lists. Text 2: 9.2, 9.3.1-9.3.3, 9.3.8, 9.3.13	9	**CO1** **CO2**
3	**Object oriented Programming**: OOP concepts, C++: First Program, data types, function definition and prototype, friend function, function overloading**Classes and Objects:** Class definition and declaration, access specifiers, scope of a class, Constructor and destructor, time class case study. Text 3: 2.1,2.2, 3.1-3.5, 9.2, 9.3, 9.5, 9.6, 9.12,9.13, 12.3 Text 4: 1.4,1,8,3.1-3.8, 6.2-6.8	9	**CO2** **CO6**
4	**Operator Overloading and Exception Handling:** Operator overloading, rules, overloading unary and binary operators, overloading prefix and postfix operators.Exception Handling, When to use an exception, throw and catch mechanisms, re-throwing an exception, handling an attempt to divide by zero, stack unwinding Text 3: 10.1-10.4,10.6,10.7 Text 4: 17.1-17.5	9	**CO3** **C04** **CO6**
5	**Inheritance:** Introduction, Base-Class Access Control, Types of inheritances: Single level, Multi level, Multiple, Hierarchical and Hybrid inheritance, constructors and destructors in inheritance, public, private and protected inheritance. Text 3: 11.1, 11.2, 11.4, 11.5 Text 4: 8.3-8.9	9	**CO5** **CO6**

TEXT BOOKS:

1. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson-Freed, 2nd Edition, 2011, Universities Press
2. Systematic Approach to Data structures using C , Padmareddy, Sri Nandi Publications, 2012
3. C++ - How to program, Paul deitel and Harvey deitel, 9th Edition, 2015, Pearson
4. "Object oriented Programming with C++", E Balagurusamy, TMH Publications, 6th Edition, 2016

REFERENCE BOOKS:

1. Data Structures using C, Y. Langsam, M. J. Augenstein and A. M. Tenenbaum, 2nd Edition, 2013, Pearson Education.
2. The C++ programming language, Bjarne Stroustrup, 4th Edition, 2013, Pearson.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE655	**PROGRAMMING WITH DATA STRUCTURES AND OOP**	
CO1	3	2
CO2	3	-
CO3	-	2
CO4	3	-
CO5	3	-
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**SEE Marks**
Remember	-
Understand	15
Apply	20
Analyze	15
Evaluate	-
Create	-

POWER ELECTRONICS

Course Code	**: 20ECE656**	**Credits**	**: 3**
L: T: P: 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 be able to:

CO1	Analyze power semiconductor devices in power electronics applications
CO2	Investigate the protection, gating and commutation circuits.
CO3	Evaluate the types of power converters for suitable power electronics applications
CO4	Choose suitable harmonic reduction methods to improve the converter performance
CO5	Analyze the performance of power converters on appropriate EDA tools
CO6	Design power converters for industrial applications

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Power Semiconductor Devices** Introduction, Construction, Principle of operation - Diode, BJT, IGBT, MOSFET, SCR, TRIAC, GTO-Static and dynamic characteristics - Two transistor model of SCR- Protection circuits - Commutation Techniques - Firing circuits. Text 2: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 5.1, 5.2, 5.6 Text 3: 20.1, 20.2, 20.5, 21.1, 21.3, 21.4, 21.5, 22.1 to 22.5, 23.1 to 23.5, 24.1 to 24.5, 25.1, 25.2, 25.3, 25.4, 25.6 Text 1: 17.5	9	**CO1, CO2**
2	**AC-DC Converter** Single phase controlled rectifiers (half, full converters and dual converters.) with R, RL load. Text 1: 10.1, 10.2, 10.3, 10.4, 10.9	9	**CO3,CO4, CO5**
3	**DC-DC Converter** DC chopper - Time ratio control and current limit control – Buck, boost, buck-boost converter – Four Quadrant chopper. **AC-AC Converter** ON-OFF control and phase control, Single phase bi-directional controllers with R and RL loads. Text 1: 5.1, 5.2, 5.3, 5.4, 5.5, 5.8.3 Text 2: 7.1, 7.2, 7.3, 7.4 Text 3: 7.3, 7.4, 7.5 Text 1: 11.1, 11.2, 11.3, 11.4, 11.5	9	**CO3 CO4, CO5**
4	**DC-AC Converter** Inverters – Single phase bridge inverters - PWM schemes - Harmonic distortion analysis-Current Source and Variable DC- link Inverter. Text 1 : 6.1, 6.2, 6.3, 6.4, 6.6, 6.9, 6.10, 6.11	9	**CO3 CO4, CO5**
5	**Industrial Applications** Drives, Heating, welding, SMPS, HVDC power transmission, static compensator, tap changers. Digital Simulation –Rectifier-Chopper -Inverter - Battery charger. Application notes and lectures	9	**CO5, CO6**

TEXT BOOKS:

1. Power Electronics - Circuits Devices and Applications, Rashid, M.H. Pearson, 4th edition, 2014.
2. Power Electronics, Bhimbra.P. S, Khanna publishers, 5thedition, 2014.
3. Power Electronics- Converters, Applications and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley and Sons, Second Edition, 2002.

REFERENCE BOOKS:

1. Thyristorised Power Controllers, Dubey.G.K, Doradia.S.R, Joshi, A. and Sinha.R.M, Wiley

Eastern Limited 4th edition, 2010.
2. Power Electronics – Converters, Applications and Design", Ned Mohan, Tore M.Underland and William P.Robins, John Wiley and Sons,4th Edition, 2012.
3. Power Electronics Essentials and Applications, Loganathan Umanand, Wiley India Pvt. Limited, 4th edition, 2010.
4. Marty Brown, Power Sources and Supplies, ELSEVIER, 2008

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECE656	**POWER ELECTRONICS**	
CO1	3	-
CO2	3	-
CO3	-	2
CO4	3	-
CO5	3	-
CO6	-	2

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	**SEE Mark**
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

COMMUNICATION LAB

Course Code : 20ECL66 | **Credits : 1.5**
L: T: P: S : 0:0:1.5:0 | **CIE Marks : 25**
Exam Hours : 3 | **SEE Marks : 25**

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

CO1	Design analog and digital modulation techniques
CO2	Demonstrate the radiation pattern of micro strip antennas
CO3	Experiment with the microwave devices to obtain performance parameters
CO4	Model an optical communication system and analyze its characteristics
CO5	Apply multiplexing and demultiplexing for band limited signals
CO6	Simulate line codes for binary baseband signaling

Mapping of Course Outcomes to Program Outcomes:

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

Sl. No.	LIST OF EXPERIMENTS	COs
1	Generation and detection of Amplitude modulation technique using transistor/FET	**CO1**
2	(a) Generation and detection of Frequency modulation technique using IC 8038/2206. (b) Demonstrate Frequency synthesis using PLL	**CO1**
3	Realize Time Division Multiplexing and Demultiplexing of two band limited signals	**CO5**
4	Generation and detection of ASK	**CO1**
5	Generation and detection of FSK	**CO1**
6	Generation and detection of PSK	**CO1**
7	Generation and detection of Pulse Code Modulation using CODEC.	**CO1**
8	Measurement of directivity and gain of microstrip dipole and Yagi antennas.	**CO2, CO**
9	Determination of (a) Coupling and isolation characteristics of microstrip directional coupler. (b) Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate. (c) Power division and isolation of microstrip power divider.	**CO3**
10	Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench.	**CO3**
11	Measurement of propagation loss, bending loss and numerical aperture of an optical fiber.	**CO4**
12	Simulation of NRZ,RZ Half Sinusoid and Raised Cosine Pulses and generate eye diagram for binary polar signaling using MATLAB/SIMULINK	**CO6**

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECL66	**COMMUNICATON LAB**	
CO1	3	2
CO2	3	-
CO3	3	-
CO4	3	2
CO5	3	-
CO6	3	2

Assessment Pattern

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	**Performance (day to day)**	**Internal test**
Marks	**15**	**10**
Remember	-	-
Understand	5	-
Apply	5	5
Analyze	5	5
Evaluate	-	-
Create	-	-

SEE- Semester End Examination (25 Marks)

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

EMBEDDED SYSTEM DESIGN LAB

Course Code : 20ECL67 | **Credits : 1.5**
L: T: P: S : 0:0:1.5:0 | **CIE Marks : 50**
Exam Hours : 3 | **SEE Marks : 50**

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

CO1	Conduct experiments to understand data transfer and memory access instructions
CO2	Construct the code for data processing using Arm instructions
CO3	Write code for given applications using bit field and process control instructions
CO4	Develop code for DSP applications using saturation and floating point operations
CO5	Use embedded C code to demonstrate peripheral interfacing with ARM development board
CO6	Construct interrupt operations for specific applications

Mapping of Course Outcomes to Program Outcomes:

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

Sl. No.	LIST OF EXPERIMENTS	COs
	CYCLE 1 EXPERIMENTS	
1.	Program involving instructions for transferring data within the processor	**CO1**
2.	ALP to demonstrate memory access instruction for various data sizes and addressing modes.	
3.	Program involving arithmetic data operations	**CO2**
4.	Program involving logic operations	
5.	Program involving data conversion operations(extend and reverse ordering)	
6.	Program involving shift and rotate operations	
7.	Program to illustrate bit field processing instruction	**C03**
8.	Program to illustrate program flow instruction.	
9.	Program to illustrate saturation operation	**C04**
10	Programs involving floating point operations	
	CYCLE 2 EXPERIMENTS	
11	Interfacing and programming GPIO ports in embedded C ARM Development Board	**C05**
a)	Program for Blinking of a LED without delay	
b)	Write a Program for Blinking of a LED with delay	
c)	Program to turn the LED ON when the button is pressed and OFF when it is released	
12	Generation of PWM signals for different duty cycles	
13	Embedded C program to demonstrate serial communication using ARM Cortex development board.	
14	Demonstrate interrupt operations using Embedded C program	**C06**
a)	Timers	
b)	Stopwatch	

Note: 1) Programming to be done using keiluvision 4 or 5 and download the program on to a M4. Evaluation board such as STM32F nucleon boards, Tiva C series board.

2) Experiments from 1 to 10 should include at least 2 to 4 programs each.

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20ECL67	**EMBEDDED SYSTEM DESIGN LAB**	
CO1	3	3
CO2	3	-
CO3	3	3
CO4	3	-
CO5	3	-
CO6	3	3

Assessment Pattern

CIE- Continuous Internal Evaluation (25 Marks)

Bloom's Taxonomy	Performance (day to day)	Internal test
Marks	**15**	**10**
Remember	5	
Understand		5
Apply	5	
Analyze	5	
Evaluate		5
Create		

SEE- Semester End Examination (25 Marks)

Bloom's Taxonomy	SEE Marks
Remember	5
Understand	10
Apply	10
Analyze	-
Evaluate	-
Create	-

MINI PROJECT-IV			
Course Code	**20ECL68B**	**Credits**	**02**
L: T:P: S	**0:0:2:0**	**CIE Marks**	**50**
Exam Hours	**03**	**SEE Marks**	**50**

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

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

CIE - Continuous Internal Evaluation (25)

Bloom's Taxonomy	Mini Project-IV
Marks (Out of 25)	**-**
Remember	-
Understand	-
Apply	10
Analyze	5
Evaluate	5
Create	5

SEE – Semester End Examination (25)

Bloom's Taxonomy	Mini Project-IV
Remember	-
Understand	-
Apply	10
Analyze	5
Evaluate	5
Create	5

CISCO - ROUTING AND SWITCHING-I

Course Code	**: 20NHOP609**	**Credits**	**: 3**
L:T:P: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 be able to:

CO1	Identify various network devices, topologies and protocols.
CO2	Construct IPv4and IPv6 addressing table and perform subnetting in IPv4 network.
CO3	Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalable networks.
CO4	Configure and troubleshoot advanced operations of routers and implement Link State routing protocols (OSPF).
CO5	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol.
CO6	Examine redundancy using Spanning tree protocols and Ether-Channel for network scalability

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hours	COs
1	**Layered Architecture:** Layered Architecture and protocols, **Network Devices:** Switches, Routers, NIC, Access Points, Modem. **Topologies:** Mesh Topology, Star Topology, Bus Topology, Ring Topology, Hybrid Topology.	8	**CO1**
	HANDS-ON 1. **Basic Router Configuration: Configure Initial Router Settings, Configure Interfaces, Configure the Default Gateway, Ping and Traceroute Testing** 2. **SSH Configuration and verify the secure access to the network device.**		

2	**IPv4 Addressing:**IPv4 Address Structure, IPv4 Unicast, Broadcast, and Multicast, Types of IPv4 Addresses, Subnetting concept **DHCPv4:** DHCP4 Concepts Configure a Cisco IOS DHCP4 Server; Configure a DHCP4 Client **IPv6 Addressing:**IPv6 Address Representation, IPv6 Address Types, **SLAAC and DHCPv6:** IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6	8	**CO2, CO3**
	HANDS-ON 1. **DHCPv4 Configuration** 2. **DHCPv6 Configuration**		
3	**Routing Concepts:** Path Determination, Packet Forwarding, IP Routing Table, Dynamic Routing, Default Static Route **Single-Area OSPF Concepts:** OSPF Features and Characteristics, OSPF Packets, OSPF Operation,	8	**CO4**
	HANDS-ON 1. **Configure IP Default Static Routes** 2. **Single-Area OSPFv2 Configuration**		
4	**VLANS:** Overview of VLANs, VLAN Configuration, VLAN Trunks, Dynamic Trunking Protocol, Inter VLAN routing	8	**CO5**
	HANDS-ON 1. **VLAN Configuration** 2. **Inter-VLAN routing Configuration**		
5	**Spanning Tree Protocol:** Purpose of STP,STP Operations, Evolution of STP,RSTP,RSTP+ **EtherChannel:** EtherChannel Operation, LACP, PAGP,	8	**CO6**
	HANDS-ON 1. **Spanning Tree Protocol Configuration** 2. **EtherChannel Configuration**		

TEXT BOOKS:

1. CISCO Netacad (ONLINE ACCESS)
2. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher (Wiley Brand), 2016.

REFERENCE BOOKS:

2. Data Communications and Networking. Forouzan,5th Edition, McGraw Hill, Reprint-2017.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

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

SEE- Semester End Examination (50 Marks)

Bloom's Taxonomy	SEE Marks
Remember	
Understand	
Apply	30
Analyze	20
Evaluate	
Create	-

PROGRAMMING OF INDUSTRIAL ROBOT	
Course Code: 20NHOP622A	**Credits: 3**
L:T:P: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 be able to:

CO1	Infer the various coordinate systems and degrees of freedom for a robot
CO2	Illustrate the robotic coordinate systems by teaching the robot
CO3	Examine the functionalities of robotic end effectors
CO4	Develop various industrial applications using FANUC Robot ER-4iA
CO5	Model various applications using Roboguide simulation tool
CO6	Experiment with FANUC Robot ER-4iA using teach pendant

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
20NHOP622A	**PROGRAMMING OF INDUSTRIAL ROBOT**											
CO1	3	3	1	1	3	1	-	-	-	-	-	1
CO2	3	3	2	1	3	-	-	-	-	-	-	1
CO3	3	3	2	1	3	-	-	-	-	-	2	1
CO4	-	3	3	3	3	-	-	-	-	-	3	1
CO5	-	3	3	3	3	-	-	-	-	-	3	1
CO6	-	3	3	3	3	-	-	-	-	-	3	1

Correlationlevels:1-Less (Low) 2-Moderate (Medium) 3-Substantial (High)

Module No	Module Contents	Hours	COs
1	**BASICS OF ROBOTICS** Basic Concepts – Definition – Three laws – Degrees of Freedom. Robot – Components of a robot, Classification of robots Articulated – Cartesian – Cylindrical – Polar – SCARA – Delta – Co-ordinate systems, Work envelope – Specifications – Pitch, yaw, roll, joint notations, speed of motion and pay load – Robot parts and their functions.	08	CO1
2	**ROBOT TEACHING** **Teach pendant programming**: Various Teaching Methods, Task Programming, Motion Interpolation. ***Hands on:*** i. Explanation on tool Orienting ii. Selection & Creation of Teach program iii. Explanation on Joint, Linear & Circular motion iv. Program testing, editing &Touch up v. Using and setting up of User frame vi. Using and setting up of Tool Frame	08	CO2, CO6
3	**ROBOT SENSORS, ACTUATORS,END EFFECTORS AND INSTRUCTION SET** **Sensors and Actuators:** PIR sensors, Optical Transducers, Servomotor, Stepper Motors. **End effectors** – Grippers: Mechanical grippers, Hydraulic & Pneumatic grippers, Magnetic grippers, Vacuum grippers, RCC grippers – Two and three fingered grippers –External grippers – Selection considerations, Gripper force analysis. **Instruction set** – Registers, Timers, Wait, Branching. ***Hands on:*** i. Practice on various I/O instructions ii. Practice on Timer/Wait and Branching Instructions iii. Practice on user Alarms	08	CO3, CO6

4	**INDUSTRIAL APPLICATIONS OF ROBOTS** **Robot Application**: Implementation of robots in industries Various steps, Machine loading/unloading. Assembly and Inspection, Feature Application, Material handling Applications – PICK and PLACE & Palletization, Robot cycle time analysis ***Hands on:*** i. Practice on Pick and Place application ii. Practice on Palletization iii. Practice on real time applications	08	CO4, CO6
5	**ROBOT PROGRAMMING AND SIMULATION** **Introduction to Robo Guide**: Create, program and simulate a robotic workcell - Integrated Virtual Teach Pendant looks and operates like a real Teach Pendant- Reach verification, collision detection, accurate cycle time and robot trajectory and other system- ***Hands on:*** Practice on i. reach verification ii. collision detection iii. accurate cycle time iv. robot trajectory v. other system	08	CO5, CO6

TEXTBOOKS:

[1]. Introduction to Robotics: mechanics and control, Craig J J, 3/E, Pearson Education India, 2008.

[2]. Deb S.R, "Robotics Technology and flexible automation", Tata McGraw-Hill Education,
2nd Edition, 2017.

[3]. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, "Technology Programming and Applications", McGraw Hill, 2012.

REFERENCE BOOKS:

[1]. Introduction to Robotics: S K Saha, Tata McGraw-Hill Education, 2008

[2]. ROBOT GUIDE MANUAL, FANUC.

Mapping of CO v/s PSO:

CO	PSO1	PSO2
20NHOP622A	**PROGRAMMING OF INDUSTRIAL ROBOT**	
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	2

Assessment Pattern

CIE-Continuous Internal Evaluation Theory (50marks)

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

SEE-Semester End Examination Theory (50 Marks)

Bloom's Taxonomy	SEE Marks
Remember	-
Understand	5
Apply	30
Analyze	5
Evaluate	5
Create	5

5G MOBILE COMMUNICATION	
Course Code : 20NHOP623A	**Credits: 3**
L:T:P:S : 3:0:0:0	**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 5G spectrum requirement, its channel model and use cases
CO2	Familiarize with 5G architecture options and physical layer concepts
CO3	Examine the multicarrier techniques and new waveform options for 5G communication
CO4	Appraise the current research avenues in 5G domain
CO5	Illustrate the concept of network slicing and V2V Communication
CO6	Interpret the Interference and Mobility management in 5G networks

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
20NHOP623A	**5G MOBILE COMMUNICATION**											
CO1	3	2	-	-	-	3	3	-	-	-	-	2
CO2	3	3	3	3	3	-	-	-	3	3	-	3
CO3	3	3	3	3	3	-	-	-	2	2	-	3
CO4	3	3	3	3	3	2	2	2	3	3	-	3
CO5	3	3	2	2	-	3	-	-	-	-	-	2
CO6	3	3	2	-	-	-	-	-	-	-	-	-

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

Module No	Module Contents	Hours	COs
1	**5G RADIO SPECTRUM:** 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies. **5G CHANNEL MODEL**: The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling. **5G USE CASES AND SYSTEM CONCEPT:** Use cases and requirements, 5G system concept. Textbook 1: 12.2,12.3,12.4, 13.1,13.2,13.3, 2.1,2.2	**8**	**CO1, CO4**
2	**RADIO INTERFACE ARCHITECTURE:** 5G architecture options, core network architecture, RAN architecture. **5G PHYSICAL LAYER:** Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming). Textbook 3: 5.1,5.2,5.3,5.4, 6.3,6.4,6.11,6.12	**8**	**CO2**
3	**5G RADIO-ACCESS TECHNOLOGIES:** Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access Textbook 1: 7.1,7.2,7.3	**8**	**CO3, CO4**
4	**INTRODUCTION TO 5G NETWORK SLICING**: Network Slicing, E2E Slicing, SDN and NFV Slicing **VEHICULAR COMMUNICATIONS:** From V2V to AV2X, key standards, VC architectures, V2X Use cases Textbook 2: 5.7	**8**	**CO4, CO5**
5	**MOBILITY AND HANDOFF MANAGEMENT IN 5G:** Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G. Textbook 1: 11.1,11.2,11.3,11.4	**8**	**CO6**

TEXTBOOKS:

1. Afif Osseiran, Jose F Monserrat, Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016
2. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies”, CRC Press, Taylor & Francis Group, First Edition, 2018
3. Harri Holma, Antti Toskala, Takehiro Nakamura, “5G Technology 3GPP NEW RADIO”, John Wiley & Sons, First Edition,2020

REFERENCES:

1. Gordon L. Stuber, "Principles of Mobile Communication", KLUWER ACADEMIC PUBLISHERS, 2nd Edition, 2002
2. Joseph C. Liberti, Theodore S. Rappaport, "Smart Antennas for Wireless Communications", Prentice Hall PTR, 1999
3. Ying Zhang, "Network Function Virtualization Concepts and Applicability in 5G Networks", John Wiley & Sons, 2018

Mapping of CO v/s PSO:

CO	PSO1	PSO2
20NHOP623A	5G MOBILE COMMUNICATION	
CO1	3	3
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

Assessment Pattern

CIE-Continuous Internal Evaluation

Theory (50marks)

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

SEE-Semester End Examination

Theory (50Marks)

Bloom's Taxonomy	SEE Marks
Remember	-
Understand	15
Apply	20
Analyze	15
Evaluate	-
Create	-

VLSI PHYSICAL DESIGN - I

Course Code	**: 20NHOP625A**	**Credits**	**: 3**
L:T:P:S	**: 3:0:0:0**	**CIE Marks**	**: 50**
Exam Hours	**: 03**	**SEE Marks**	**: 50**

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

CO1	Analyze the pre-requisites required for back-end VLSI design flow and its implementations
CO2	Gain sufficient practical knowledge on LINUX, GVIM editor usage and apply the scripting skills for the VLSI tools
CO3	Understand VLSI Synthesis and Evaluate the functionality of RTL and netlist
CO4	Understand timing analyses at various process and environment
CO5	Apply the learnt concepts of STA to evaluate the delay of the circuits.
CO6	Engage in independent learning and perform the timing and power report analysis

Mapping of Course Outcomes to Program Outcomes

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

Module No	Module Contents	Hours	COs
1	**GVIM Editor**: GVIM Introduction, Features of GVIM, Create new file, Open file in Read-Only mode, Edit existing file, Basic modes, Insert, Append, Open new line, Substitute, Change, Replace, Join, VIM Navigating, Buffer, Swap files, Cut, copy, delete, paste actions, Undo and redo actions, Search settings , Search in current file ,Search in multiple files , Search in help files, Working with multiple files, buffers, Markers, Macros, Diff, Recording, Remote file editing Ref 2, Chapter 1,2,3,4,9,11,12,13,14,16	8	CO1,CO2
2	**Basics of Linux:** Linux commands, File management, Directories, File Permission, Basic utilities. Pipes and filters, Processes, Communication, shell scripting, Advanced Linux : Regular expressions, File system Basics **TCL :**Basic syntax, Commands, Operators, Loops, Arrays, Strings, Lists, Procedures, Packages, Files I/O, Regular expressions Text 1, Chapter 2,3,11 Reference 3, Chapter: 1,5,6,8,9	8	CO1,CO2
3	**Logic Synthesis:** Introduction to Logic Synthesis, Goals of Synthesis, Synthesis Flow, Input and Output of Synthesis Reference 4	8	CO1,CO3
4	**Introduction to STA:** Nanometer Designs, What is Static Timing Analysis? Why Static Timing Analysis?, Crosstalk and Noise, Design Flow, CMOS Digital Designs, FPGA Designs, Asynchronous Designs, STA at Different Design Phases, Limitations of Static Timing Analysis, Power Considerations Text 3: Chapter 1	8	CO4
5	**STA Concepts:** Standard Cells, Propagation Delay, Slew of a Waveform, Skew between Signals, Timing Arcs and Unateness, Min and Max Timing Paths, Timing Modeling, Wireload Models, Crosstalk Glitch analysis, Configuring STA Environment, Setup and Hold Timing Check Text 3:2.1.3,2.4,2.5,2.6,2.7,2.8,3.2,4.2,6.2,7.2,8.1 and 8.2	8	CO5, CO6

TEXT BOOKS:

1. Beginning Linux Programming, 4th Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
2. Richard Peterson, "Linux: The Complete Reference", sixth edition, Mc-Graw Hill, 2008
3. J. Bhasker, R Chadha, "Static Timing Analysis for Nanometer Designs: A Practical Approach", Springer, 2009

REFERENCE BOOKS:

1. Sridhar Gangadharan, Sanjay Churiwala, "Constraining Designs for Synthesis and Timing Analysis – A Practical Guide to Synopsis Design Constraints (SDC)", Springer, 2013.
2. https://www.iopb.res.in/vimbook-OPL.pdf
3. **https://www.ee.columbia.edu/~shane/projects/sensornet/part1.pdf**
4. **https://www.vlsi-backend-adventure.com/logic_synthesis.html**
5. **https://www.ee.columbia.edu/~shane/projects/sensornet/part1.pdf**

Mapping of CO v/s PSO:

COs	PSO1	PSO2
20NHOP625A	**VLSI PHYSICAL DESIGN-I**	
CO1	2	3
CO2	2	3
CO3	2	3
CO4	2	3
CO5	2	2
CO6	2	3

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	-	-

SEE- Semester End Examination

Theory (50 Marks)

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

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.

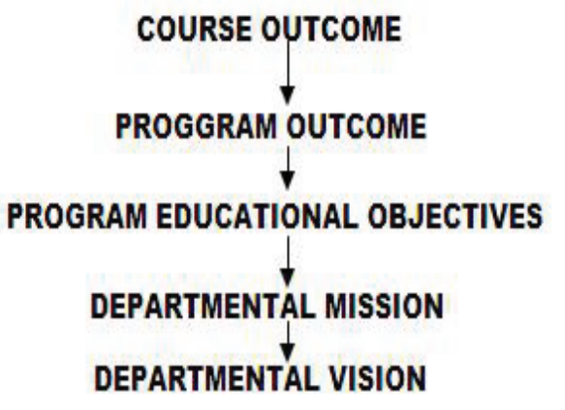
There are three educational Outcomes as defined by the National Board of Accreditation:

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 and design 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 straightforward 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.

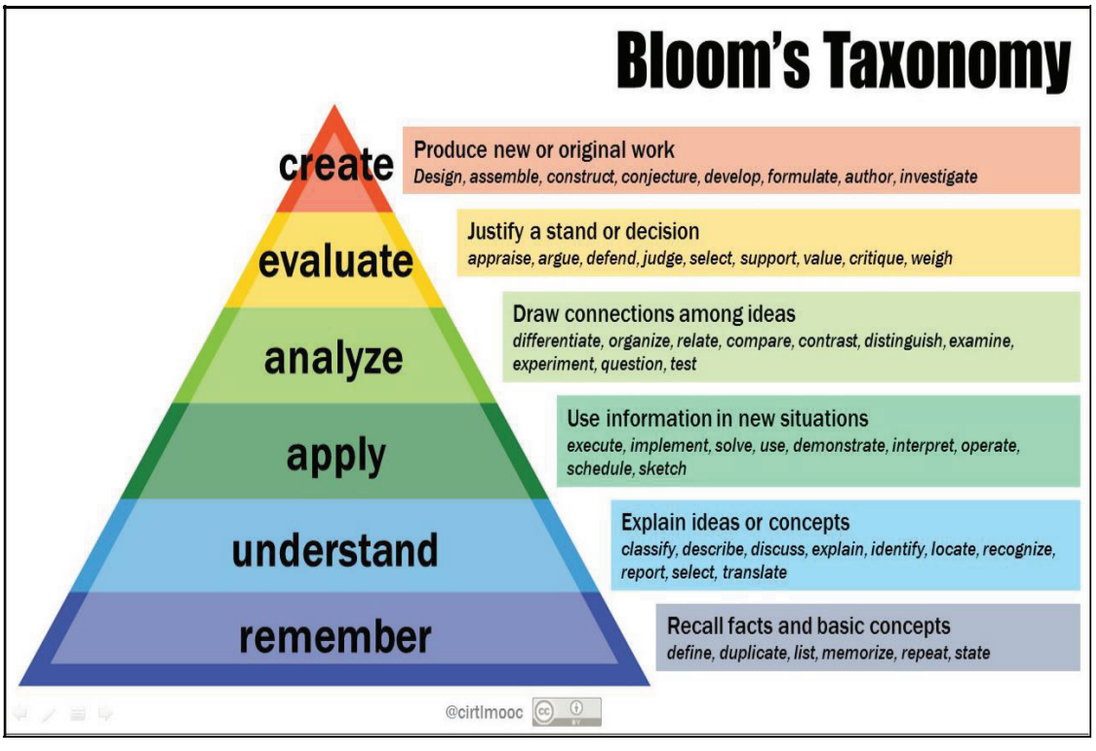
Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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.



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