

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 (Fourth) Final Year BE

Academic Year 2022-23

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## 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.

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

#### **Program Education objectives (PEOs)**

#### **PEO to Mission Statement Mapping**

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

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

## **Program Outcomes (PO) with Graduate Attributes**

	Graduate Attributes	Program Outcomes (POs)
1	Engineering knowledge	<b>PO1:</b> 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	<b>PO2:</b> 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	<b>PO3:</b> 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	<b>PO4:</b> 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	<b>PO5:</b> 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	<b>PO6:</b> 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	<b>PO7:</b> 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	<b>PO8:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	<b>PO9:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	<b>PO10:</b> 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	<b>PO11:</b> 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	<b>PO12:</b> 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**

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

	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

## Mapping of PEOs to POs & PSOs

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

## New Horizon College of Engineering Department of Electronics and Communication Engineering Scheme of Seventh Semester (Autonomous) B.E Program – Batch: 2019-2023

Academic Year 2022-2023 (ODD)

			Seme	ester <b>\</b>	VII							
				Cre	edit D	istribu	tion				Marks	3
Sl. No.	Course Code	Course	BoS	L	Т	Р	s	Overall Credits	Contact hours	CIE	SEE	Total
1	20ECE71A	Wireless Communication	ECE	3	0	0	0	3	3	50	50	100
2	20ECE72A	Antennas and Wave Propagation	ECE	3	0	0	0	3	3	50	50	100
3	20ECE73A	Fiber Optic Communication	ECE	3	0	0	0	3	3	50	50	100
	20ECE74XA	<b>Professional Elective-IV</b>	ECE									
	20ECE741A	Embedded Computing	ECE									
	20ECE742A	Advanced Semiconductors	ECE									
4	20ECE743A	Satellite Communications	ECE	3	0	0		3	3	50	50	100
	20ECE744A	Biomedical Signal Processing	ECE									
	20ECE745A	Artificial Intelligence and Cognitive Computing	ECE									
	20ECE746A	Software Defined Radio	ECE									
	20ECE75XA	Professional Elective-V	ECE									
	20ECE751A	Robotics	ECE									
	20ECE752A	Low Power VLSI Design	ECE									
5	20ECE753A	Wireless Ad-hoc Sensor Networks	ECE	3	0	0	0	3	3	50	50	100
	20ECE754A	VLSI Signal Processing	ECE									
	20ECE755A	Neural Networks	ECE									
	20ECE756A	Renewable Energy	ECE									
6	20ECL76A	Advanced Communication Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
7	20ECL77A	EDA Software Workshop Lab	ECE	0	0	1.5	0	1.5	3	25	25	50
8	20ECL78A	Project Phase-1	ECE	0	0	2	0	2	4	25	25	50
	20NHOPXXX	Open Elective-II	ECE									
	20NHOP709	CISCO - Routing and Switching-1	ECE									100
9	20NHOP712	CISCO- Routing and Switching-2	ECE	3	0	0	0	3	3	50	50	
	20NHOP718A	Physical Design	ECE									
	20NHOP722A	Programming of Industrial Robot	ECE									
	20NHOP723A	5G Mobile Communication	ECE									
		Total						23	28	375	375	750

	New Horizon College of Engineering Department of Electronics and Communication Engineering Scheme of Eighth Semester (Autonomous) B.E Program – Batch: 2019-2023 Academic Year 2022-2023 (EVEN) Semester VIII											
	Semester v m											
SI. No.	Course Code	Course	BoS	Cre L	edit Di	P	ition S	Overall Credits	Contact hours	CIE	SEE	TOTAL
	20ECE81XA	Professional Elective-VI	ECE									
	20ECE811A	Internet of Things	ECE	-				3		50	50	
	20ECE812A	VLSI Design Manufacturing	ECE	-					3			
1	20ECE813A	Cellular Mobile Communication	ECE	3	0	0	0					100
	20ECE814A	Industrial Automation	ECE									
	20ECE815A	Python and R Programming	ECE									
	20ECE816A	Optical Networks	ECE									
	20ECE82XA	Professional Elective-VII	ECE								50	100
	20ECE821A	Switching & Finite Automata Theory	ECE									
	20ECE822A	Digital Neurocomputing	ECE									
2	20ECE823A	Pattern Recognition and Application	ECE	3	0	0	0	3	3	50		
	20ECE824A	Radar Networks	ECE									
	20ECE825A	Wireless and High speed ICs and Systems	ECE									
	20ECE826A	Block Chain Technology	ECE									
3	20ECL83A	Internship	ECE	0	0	0	0	4	0	50	50	100
4	20ECL84A	Project Phase-2	ECE	0	0	10	0	10	20	150	150	300
						,	Total	20	26	300	300	600

## SEVENTH SEMESTER

## (SYLLABUS)

#### **Wireless Communication**

<b>Course Code</b>	: 20ECE71A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
<b>Exam Hours</b>	: 3 Hrs	SEE Marks	: 50

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

COI	Understand the basics of wireless communication and evolution of wireless
COI	communication standards with time
CO2	Choose appropriate radio signal propagation model for different communication
	systems
CO3	Recognize GSM and CDMA basic operations and call setup processes
CO4	Appraise the significance of multi carrier modulation techniques in current
04	communication scenario
CO5	Identify the application areas of modern communication techniques
CO6	Apply the concept of smart multi antenna systems for advanced wireless communication

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

SYLLABUS				
Module No	Module Contents	Hours	COs	
1	Introduction to wireless communication systems Evolution of wireless communication systems, Examples of wireless communication systems. Cellular concept - Frequency reuse - channel assignment strategies - hand off strategies - interference & system capacity – trunking & grade of service – Improving coverage and capacity in cellular system. Text Book 1: 1.1,1.4, 3.1,3.2,3.3,3.4, 3.5, 3.6, 3.7	9	CO1	
2	<b>Free Space Propagation Model</b> Three Basic Propagation mechanism – Reflection (Ground Reflection -Two Ray model), Diffraction(knife-edge diffraction model)and Scattering ,model - Link Budget design using Path Loss model(log normal shadowing) Outdoor and Indoor Propagation models –Okumura model, Hata model, log	9	CO1,CO2	

	distance path loss model Small scale multipath propagation -		
	Parameters of mobile multipath channels – Types of small		
	scale fading -Fading effects due to Multipath time delay		
	spread and Fading effects due to Doppler spread - Rayleigh		
	and Rician distribution.		
	Text Book 1:4.1, 4.2, 4.4, 4.5, 4.6, 4.7, 4.8,		
	4.9,4.10,4.11,5.4,5.5,5.5.1,5.5.2, 5.6		
	Wireless standards		
	Introduction to wireless standards - 1G-AMPS, 2G. GSM		
	services and features, System architecture, Radio subsystem,		
3	channel types, Frame structure for GSM	9	CO1,CO3
	CDMA (IS-95) - CDMA frequency bands, Forward and		
	Reverse CDMA Channel.		
	Text Book 1: 11.1, 11.3, 11.4		
	OFDM for Wireless Communication		
	Basic principles of orthogonality, single Vs Multi-carrier		
4	systems, ODFM Block diagram, OFDM signal mathematical	9	CO4,CO5,
4	representation, pilot insertion and channel estimation		
	Text Book 2: 9.1, 9.2, 9.3, 9.4, 9.9		
	Multipath Mitigation Techniques		
	Diversity – Types of Diversity – Diversity combining		
5	techniques: Selection, Feedback, Maximal Ratio Combining		
	and Equal Gain Combining	0	CO4,
	Introduction to MIMO, MIMO based system architecture,	9	CO5,CO6
	MIMO channel modeling, Advantages and applications of		
	MIMO		
	Text Book 2: 15.1, 15.2, 15.3, 15.8, 15.13		

#### **Text Books:**

1. Rappaport T.S., "Wireless communications", Pearson Education, 2014.

2. Wireless Communication — UpenDalal, Oxford Univ. Press, 2009

#### **Reference books:**

1. Lee, W.C.Y., Mobile Communication Engineering, McGraw Hill, 2017.

2. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.

3. Andreas.F. Molisch, "Wireless Communications", John Wiley India, 2006.

4. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.

## Mapping of CO v/s PSO:

-	PSO1	PSO2	
20ECE71A	Wireless Communication		
CO1	-	-	
CO2	-	-	
CO3	-	-	
CO4	3	3	
CO5	3	3	
CO6	3	3	

#### **Assessment Pattern**

## CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	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	-

## Antennas and Wave Propagation

Course Code: 20ECE72A	Credits	:3
L: T:P:S : 3:0:0:0	<b>CIE Marks</b>	:50
Exam Hours: 3 Hrs	SEE Marks	: 50

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

CO1	Understand basic antenna parameters and mathematical representations			
CO2	Interpret the radiation pattern of antenna arrays for complex engineering problems			
CO3	Analyze radiation integrals and auxiliary potential for antennas			
<b>CO</b> 4	4Make use of mathematical analysis of electric short dipole and linear wire antennas in describing the characteristics of antennas			
CO5	Design antenna systems for Multidisciplinary domain with appropriate consideration for public health and safety			
CO6	Choose proper atmospheric layer for wave propagation with respect to environmental consideration			

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
C05	3	3	3	1	-	1	1	1	-	-	-	1
CO6	3	-	-	-	-	-	-	-	-	-	-	-

SYLLABUS				
Module No	Module Contents	Hours	COs	
	UNIT 1: FUNDAMENTELS OF ANTENNA: Introduction,	9	CO1,	
	Radiation patterns, Radiation Power Density and intensity,		CO2	
	Beam-width, Directivity, Antenna Efficiency, Gain, Beam			
	Efficiency, Bandwidth, Polarization, Input Impedance, Antenna			
	Radiation Efficiency, Vector Effective Length and Equivalent			
1	Areas, Maximum Effective Area, Antenna temperature, Friis			
	Equation. Antenna field zones.			
	Text1:			
	2.2,2.3,2.4,2.5,2.6,2.8.2.9,2.10,2.11,2.12,2.13,2.14,2.15,2.16,			
	Text2 : 2.1,2.2,2.3,2.4,2.5,2.6,2.7,7.1,7.2,7.3,7.4,7.5	0	<u> </u>	
	UNIT 2: RADIATION INTEGRALS AND AUXILIARY	9	003	
	FOIENTIAL: Introduction, The Vector Potential for an			
	Electric and Magnetic Current Sources Solution of Wave			
2	Equation Ear-Field Radiation Duality Reciprocity and			
	Reaction Theorems			
	Text1: 31.3.2.3.3.4.3.5.3.6.3.7.3.8			
	Text 2 : 1.1. 1.2			
	UNIT 3: LINEAR WIRE ANTENNAS: Introduction,	9	CO4	
	Infinitesimal Dipole, Small Dipole, Region Separation, Finite	-		
	Length Dipole, Half-Wavelength Dipole, Linear Elements Near			
2	or on Infinite Perfect Conductors, Ground Effects. Types of			
3	Antennas and their characteristics- Yagi Uda, Micro-strip			
	and Horn antennas.			
	Text 1: 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 13.1, 13.2, 14.1, 14.2.			
	Text2 : 6.3,6.9			
	UNIT 4: ANTENNA ARRAYS: LINEAR, PLANAR, AND	9	CO5	
	CIRCULAR: Introduction, Two-Element Array, N-Element			
	Linear Array: Uniform Amplitude and Spacing, Directivity, N-			
4	Element Linear Array: N-Element Uniform Spacing, Non-			
	uniform Amplitude, Planar Array, Circular Array.			
	Text1: 6.1, 6.2, 6.3, 6.4, 6.5, 6.10, 6.11, 6.12.			
	Text2 :5.1,5.2,5.3,5.4	0	60(	
	UNIT 5: WAVES PROPAGATION: Introduction, Ground	9	006	
5	wave propagation, free space propagation, ground reflection,			
	propagation electrical properties of the ionosphere effects of			
5	earth's magnetic field			
	Text1 ·16 4			
	Text2:8.1.8.2.			

#### **Text Books:**

1. "Antenna Theory, Analysis, and, Deign" – C. A. Balanis, 3<sup>rd</sup> Edition, John Wiley India Pvt. Ltd., 2008.

2. "Antennas and Wave Propagation" - Harish and Sachidananda: Oxford Press 2007.

#### **Reference Books:**

1. "Antennas and Wave Propagation," John D. Krauss, 4th En, McGraw-Hill International edition, 2010.

2. "Antennas and Propagation for Wireless Communication Systems" – S. R. Saunders, John Wiley, 2003.

3. "Antennas and Wave Propagation", - G S N Raju, Pearson Education, 2005.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2		
20ECE72A	Antennas and Wave propagation			
CO1	-	-		
CO2	3	3		
CO3	-	-		
CO4	3	3		
CO5	3	3		
CO6	3	3		

#### Assessment Pattern

<u>CIE – Continuous Internal Evaluation (50 Marks)</u>

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

## <u>SEE – Semester End Examination (50 Marks)</u>

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

## Fiber Optic Communication

<b>Course Code</b>	: 20ECE73A	Credits	:3
L: T:P:S	: 3:0:0 :0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Apply the fundamentals of optical fiber communication in modern communication systems
CO2	Identify suitable Optical fiber structure for a specific application
CO3	Analyze the effect of channel impairments in Optical Fiber communication systems
<b>CO4</b>	Assess the performance of optical receivers
CO5	Utilize the theory of optical multiplexers for networking applications
CO6	Illustrate different concepts for creating optical amplification

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

SYLLABUS							
Module No	Module Contents	Hours	COs				
1	<b>OVERVIEW OF OPTICAL FIBER COMMUNICATION:</b> Historical development, The General System, advantages, disadvantages, and applications of optical fiber communication, Raytheory, Electromagnetic mode theory, cylindrical fiber (no derivations in section 2.4.4), single mode fiber, cutoff wave length, mode filed diameter. Text Book 1: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3.1, 2.3.2, 2.3.3, 2.4, 2.5.1, 2.5.2	9	CO1				
2	OPTICAL SOURCES AND TRANSMISSION CHARACTERISTICS OF OPTICAL FIBERS: Optical sources: LED, power and efficiency, LED structures, LED characteristics, LASER basic concepts, The Semiconductor Injection LASER Attenuation, absorption, scattering losses, bending loss, dispersion, Chromatic dispersion, Inter model dispersion.	9	CO2, CO3				

	Text Book 1: 7.2,7.3.1,7.3.2,7.3.3,7.3.4, 7.4,6.2,6.4,3.1, 3.2 3.3, 3.4,		
	3.6, 3.8, 3.9, 3.10		
3	<b>OPTICAL RECEIVER:</b> Physical Principles of Photo diodes, PIN and APD, Photo detector noise. Optical Receiver Operation, receiver sensitivity, quantum limit, eye diagrams, coherent detection Text Book2: 6.1.1,6.1.2, 6.2, 7.1, 7.2.2, 7.2.3,7.3, 7.4	9	CO4, CO6
4	<b>OPTICAL AMPLIFIERS:</b> Basic Applications and types of Optical amplifiers, semiconductor optical amplifiers, EDFA, Amplifier Noise, Optical SNR Text Book2: 11.1,11.2,11.3,11.4,11.5	9	CO4, CO6
5	<b>WDM CONCEPTS AND OPTICAL NETWORKS:</b> Overview of WDM- operation principles, WDM standards, Mach-Zehender interferometer multiplexer, Isolators and circulators, Optical network concepts, network topologies, SONET/SDH, Optical Add/Drop Multiplexing Text Book2:10.1.1, 10.1.2,10.2.5,10.3,13.1,13.2,13.3,13.5	9	CO5

#### **TEXT BOOKS:**

1. "**Optical Fiber Communications**", John M. Senior, Pearson Education, Second Edition, 7th Impression, 2010.

2. "Optical Fiber Communication", Gerd Keiser, 4th Ed., MGH, 2008.

#### **REFERENCE BOOK:**

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

Mapping of CO v/s PSO:

-	PSO1	PSO2				
20ECE73A	Fiber Optic Communication					
CO1	-	-				
CO2	-	-				
CO3	3	3				
CO4	3	3				
CO5	-	-				
CO6	3	3				

#### **Assessment Pattern**

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

#### CIE- Continuous Internal Evaluation (50 Marks)

## SEE- Semester End Examination (50 Marks)

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

## **Embedded Computing**

<b>Course Code</b>	: 20ECE741A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3	SEE Marks	: 50

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

CO1	Understand the characteristics of embedded computer systems
CO2	Analyze the mechanism of Interrupts in embedded computing systems
CO3	Make use of Interrupt Service Mechanism for programming I/O Devices
CO4	Identify the design and development approaches
CO5	Evaluate the testing and debugging environment for embedded computing systems
CO6	Model the real time computing applications
•	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	2	-	3
CO3	3	3	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	2	2	-	-	-	2	2	2	3
CO5	3	3	3	-	2	-	-	-	2	-	2	-
CO6	3	-	3	-	-	2	2	-	2	2	-	3

Module	Module Contents	Hours	Cos
No			
1	Introduction to embedded systems: Embedded systems, Processor embedded into a system, Embedded hardware units and device in a system, Embedded software in a system, Examples of embedded systems. Devices and communication buses for devices network: IO types and example, Serial communication devices, Parallel device ports, Sophisticated interfacing features in device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, Networked embedded systems <b>Text1:1.1-1.5,3.1-3.9</b>	9	CO1

2	Device drivers and interrupts and service mechanism: Programming-I/O busy-wait approach without interrupt service mechanism, ISR concept, Interrupt sources, Interrupt servicing (Handling) Mechanism, Multiple interrupts, Context and the periods for context switching, interrupt latency and deadline, Classification of processors interrupt service mechanism from Context-saving angle, Direct memory access, Device driver programming <b>Text1:4.1-4.9</b>	9	CO2
3	Inter process communication and synchronization of processes, Threads and tasks: Multiple process in an application, Multiple threads in an application, Tasks, Task states, Task and Data, Clear-cut distinction between functions. ISRS and tasks by their characteristics, concept and semaphores, Shared data, Inter process communication, Signal function, Semaphore functions, Message Queue functions, Mailbox functions, Pipe functions, Socket functions, RPC functions. <b>Text1: 7.1-7.16</b>	9	CO3
4	Design process in embedded system, Formalization of system design, Design process and design examples Embedded Firmware Design Approaches, Embedded Firmware Development Languages, Programming in Embedded C Text1:1.8-1.10, Text2: 9.1-9.3	9	CO4
5	Embedded Software Development Process and tools: Introduction to Embedded Software Development Process and tools, Host and target machines, Linking and locating software, Getting Embedded software into the target system, Issues in Hardware-Software Design and co-design, Testing on Host machine, Simulators, Case studies and application of embedded computing systems <b>Text1:13.1-13.5,14.1,14.2,11.1,11.2,12.1,12.2</b>	9	CO5,CO6

#### **TEXT BOOKS:**

- Raj Kamal, "Embedded Systems: Architecture, Programming, and Design" 2<sup>nd</sup> / 3<sup>rd</sup> edition, Tata McGraw hill-2013
- 2. Shibu K.V, "Introduction to Embedded Systems"2<sup>nd</sup>, Tata McGraw hill
- 3. Stuart Bennett, "Real Time Computer Control" second edition ,2010

#### **REFERENCE BOOKS:**

1. Marilyn Wolf, "Computer as Components, Principles of Embedded Computing System Design" 3<sup>rd</sup> edition, Elsevier-2014.

2. Embedded Systems Architecture – A Comprehensive Guide for Engineers and Programmers, Tammy Noergaard, Elsevier Publication, 2005.

3. Embedded Systems – A contemporary Design Tool, James K. Peckol, John Weily India Pvt. Ltd, 2008

#### Mapping of CO v/s PSO:

-	PSO1	PSO2			
20ECE741A	Embedded Computing				
CO1	-	-			
CO2	3	2			
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	Tests
Remember	10
Understand	10
Apply	20
Analyze	10
Evaluate	-
Create	-

#### **Advanced Semiconductors**

<b>Course Code</b>	: 20ECE742A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the principles and fundamentals of semiconductor devices		
CO2	Apply the basics of Quantum mechanics for the formulation of atomic structure		
CO3	Estimate the energy levels of semiconductors		
<b>CO4</b>	Analyze the device structures in 1-D as well as in 3-D		
CO5	Interpret the carrier concentration distribution for the formulation of intrinsic and		
003	extrinsic semiconductors		
CO6	Model the formulation of the continuity equation, with reference to different types of		
	carrier movements in semiconductors		

	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	PO100	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-
CO3	3	3	-	3	-	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	-	-	-	-	2
CO5	3	3	2	3	-	-	-	-	-	-	-	-
CO6	3	3	-	3	-	-	-	-	-	-	-	2

	SYLLABUS					
Module No	Module Contents	Hours	COs			
1	<b>Basic Semiconductor Properties</b> : General Material Properties, Crystal Structure, The Unit Cell Concepts, Simple 3-D Unit Cells, Bravais Lattices and Crystal Systems, Specific Semiconductor Lattice, Miller Indices, Use of Miller Indices, Wafer Surface Orientation, Wafer Flats and Notches, Pattern Alignment. Exercises.	9	CO1			
2	<b>Elements of Quantum Mechanics</b> : The Quantum Concept, Blackbody Radiation, The Bohr Atom, Wave-Particle Duality, Basic Formalism - General Formulation, Time-Independent Formulation, The Free Particle, Particle in a 1-D Box, Exercises.	9	CO2			
3	<b>Energy Band Theory</b> : Preliminary Considerations, Approximate One-Dimensional Analysis, Extrapolation of Concepts to Three Dimensions, Band Gap Energy, Exercises.	9	CO3, CO4			

4	<b>Equilibrium Carrier Statistics</b> : Density of States - General Derivation, Specific Materials, Fermi Function, Supplemental Information, Equilibrium Distribution of Carriers, The Energy Band Diagram, Equilibrium Concentration Relationships, Concentration and EF Calculations, General Information, Equilibrium Carrier Concentration, Freeze-Out/Extrinsic and Intrinsic, Exercises	9	CO5
5	<b>Carrier Transport</b> : Drift and Diffusion Visualization, Diffusion Current, Einstein Relationship, Equations of State, Current Equations, Carrier Currents, Dielectric Displacement Current, Quasi Fermi Levels, Continuity Equations, Minority Carrier Diffusion Equations, Exercises.	9	CO6

#### **TEXT BOOKS:**

1. Advanced Semiconductor Fundamentals, Robert F Pierret, Pearson Prentice Hall, Second edition, 2002.

#### **REFERENCE BOOKS:**

1. Solid State Electronic Devices, Ben G. Streetman and Sanjay Kumar Banerjee, Pearson Seventh edition, 2015.

Mapping of CO v/s PSO:

-	PSO1	PSO2	
20ECE742A	Advanced Semiconductors		
CO1	-	-	
CO2	2	2	
CO3	-	-	
CO4	2	2	
CO5	_	-	
CO6	2	2	

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

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

## SEE- Semester End Examination (50 Marks)

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

#### **Satellite Communications**

<b>Course Code</b>	: 20ECE743A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	:50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Distinguish signal loss factors in satellite communication for categorized
	noises/perturbations
CO2	Apply Kepler laws and understanding satellite orbits
CO3	Examine process involved in communication between transmitters and receivers
	with respect to satellite communication
CO4	Identify the working of earth segment and space segment of satellite
004	communication.
CO5	Examine satellite services &Satellite Access Techniques at different uplink and
	downlink frequencies
CO6	Construct satellites through student satellite programs

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

SYLLABUS								
Module No	Module Contents	Hrs	Cos					
1	FUNDAMENTALS OF SATELLITE AND PROPAGATIONIMPAIRMENTSIntroduction, frequency allocation, INTELSAT, Indian Satellitesystems.PROPAGATION IMPAIRMENTS: Introduction, atmosphericloss, ionospheric effects, rain attenuation, other propagationimpairments. (T1, $1.1 - 1.3$ ; $4.1 - 4.5$ )	9	CO1					
2	<b>ORBITS</b> Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane and sun synchronous orbits. Geostationary orbit: Introduction, antenna look angles, polar mount antenna, limits of visibility, earth eclipse of satellite, sun transit outage. (T1, $2.1 - 2.8$ ; $2.9.1$ , $2.9.2$ , $2.9.4$ , $2.9.5$ , $3.1 - 3.4$ , $3.6$ , $3.7$ )	9	CO1, CO2					

3	<ul> <li>SPACE SEGMENT AND SPACE LINK: Introduction, power supply units, altitude control, station keeping, thermal control, TT&amp;C Subsystem, transponders, antenna subsystem.</li> <li>SPACE LINK: Introduction, EIRP, transmission losses, link power budget Equation, system noise, CNR, uplink and downlink, combined CNR (T1, 7.1 – 7.8; 12.1 -12.8 &amp; 12.10)</li> </ul>	9	CO4, CO5, CO6
4	EARTHSEGEMENT& SATELLITEACCESSTECHNIQUES:Introduction, receive only home TV system, outdoor unit, indoorunit, MATV, CATV, Tx–Rx earth station.(T1, 8.1 – 8.3; 8.4 & 8.5)SatelliteAccessTechniques – Bandwidth-Limited and Power-Limited, TDMADownlinkanalysisforFDMAandTDMA, On-BoardSignalProcessingforFDMA/TDMOperation,SatelliteswitchedTDMA.(T1: 14.6, 14.7.11-12,14.8, 14.9)	9	CO4, CO5, CO6
5	<b>DBS, SATELLITE MOBILE AND SPECIALIZED</b> <b>SERVICES:</b> Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, VSAT, Radar Sat. GPS: Introduction, GPS position and location principles, GPS receiver and codes, Orbcomm. (T1, 16.1 - 16.6, 17.2 - 17.6)	9	CO3, CO5, CO6

#### **Text Books:**

1. Dennis Roddy, "Satellite Communications", 4th Edition, McGraw-Hill International edition, 2006.

#### **Reference Books:**

- 1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "Satellite Communications", 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.
- 2. W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, "Satellite Communication Systems Engineering", 2nd Ed., Pearson Education., 2007.
- 3. W. L. Pritchart, H. G. Suyderhoud and R. A. Nelson, "Satellite Communication Systems Engineering," 2nd Edition, Pearson Education, 2012.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2
20ECE743A	Satellite	Communications
CO1	-	-
CO2	-	-
CO3	3	3
CO4	-	-
C05	3	3
CO6	3	3

#### Assessment Pattern

#### <u>CIE – Continuous Internal Evaluation (50 Marks)</u>

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

#### <u>SEE – Semester End Examination (50 Marks)</u>

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

## **Biomedical Signal Processing**

<b>Course Code</b>	: 20ECE744A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
<b>Exam Hours</b>	: 3 Hrs	SEE Marks	: 50

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

CO1	Describe the origin, properties and suitable models of biomedical signals such as
	ECG and EEG
CO2	Apply signal processing methods to extract relevant information from biomedical
	signal measurements
CO2	Develop the relevant mathematical and computational skills relevant in compression
005	of biomedical signals
CO4	Analyze the ECG Signal behavior using signal processing methods
CO5	Analyze the rhythms and detection process in neurological signal processing
CO6	Examine the quality of biomedical images acquired from Computed Tomographic
	Imaging and Ultrasound Imaging modalities

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

SYLLABUS							
Module No	Module Contents	Hrs	COs				
1	<ul> <li>Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis.</li> <li>Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.</li> <li>Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.</li> <li>Text Book no : 1 Sections :1.1,2.1-2.3,3.2-3.4; 9.1-9.5.</li> </ul>	9	CO1, CO2				

2	<ul> <li>Adaptive Noise Cancelling: Principal noise canceller model, 60- Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.</li> <li>Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding, data reduction algorithms, usage of Fourier transform, Correlation, Convolution, Power spectrum estimation for analysis of ECG signal time and frequency domains.</li> <li>Text Book no : 1 Sections : 8.1-8.3,10.1-10.4,11.1-11.4</li> </ul>	9	CO2,CO3
3	<b>Electrocardiography:</b> Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor. Text Book no: 2 Sections: 7.1-7.4 Text Book no: 1 Sections :12.1-12.6,13.1-13.3	9	CO4
4	Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection. Text Book no: 2 Sections :4.1-4.4	9	CO5
5	<ul> <li>Biomedical Image Processing using CT: Introduction, CT Instrumentation, Image Formation, Image Quality in CT.</li> <li>Biomedical Image Processing using Ultrasound: Introduction, Instrumentation, Pulse-Echo Imaging, Transducer Motion, Ultrasound Imaging Modes, Steering and Focusing, 3-D Ultrasound Imaging, Image Quality.</li> <li>Text Book no: 3 Sections :6.1-6.4, 11.1-11.8</li> </ul>	9	CO6

#### **Textbooks:**

- 1. W. J. Tompkins, "Biomedical Digital Signal Processing," PHI Learning Private Limited, New Delhi, India, 2015.
- 2. D. C. Reddy, "Biomedical Signal Processing: Principles and techniques," Tata McGraw-Hill, New Delhi, India, 2015.
- 3. J. L. Prince, and J. M. Links, "Medical Imaging Signals and Systems," Pearson Education, Inc., New Delhi, India, 2015.

#### **References:**

- 1. R. Rangayyan, "Biomedical Signal Analysis," Wiley India Private Limited, New Delhi, India, 2015.
- 2. Bruce, "Biomedical Signal Processing & Signal Modeling," John Wiley and Sons, Singapore, 2001.
- 3. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications," Reed Elsevier Private Limited, New York, U.S.A., 2009.
- 4. Semmlow, "Biosignal and Biomedical Image Processing," Marcel Dekker, London, U.K., 2004
- 5. Enderle, "Introduction to Biomedical Engineering," 2<sup>nd</sup> Edition, Reed Elsevier Private Limited, New York, U.S.A., 2005.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2		
20ECE744A	<b>Biomedical Signal Processing</b>			
CO1	-	-		
CO2	3	3		
CO3	3	3		
CO4	3	3		
CO5	3	3		
CO6	3	3		

#### **Assessment Pattern**

<u>CIE – Continuous Internal Evaluation (50 Marks)</u>

<b>Bloom's Taxonomy</b>	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	5		
Understand	5		
Apply	10		5
Analyze	5	15	5
Evaluate			
Create			

#### <u>SEE – Semester End Examination (50 Marks)</u>

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

## Artificial Intelligence and Cognitive Computing

<b>Course Code</b>	: 20ECE745A	Credits	:3
L:T:P:S	: 3:0:0 :0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Apply the searching methods in Artificial Intelligence
CO2	Use the rules of Artificial Intelligence for knowledge representation
CO3	Examine the different reasoning and learning techniques
CO4	Distinguish the week and strong, slot and filler structures
CO5	Analyze the architecture of Cognitive computing system
CO6	Engage in self learning by performing cognitive analytics

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

	SYLLABUS		
Module No	Module Contents	Hrs.	Cos
1	<b>Introduction:</b> Definition of artificial intelligence, Problems, Problem Spaces and search, Heuristic search technique. (Text1: 1.1 to 1.7, 2.1 to 2.6, 3.1 to 3.6)	9	CO1
2	Knowledge Representation: Its issues, Using Predicate Logic, representing knowledge using Rules. (Text1: 4.1 to 4.4, 5.1 to 5.5)	9	CO2
3	<b>Statistical reasoning and Slot-Filler structures:</b> Symbolic Reasoning under Uncertainty, Statistical reasoning, Weak Slot and Filler Structures, Strong slot-and-filler structure. (Text1: 8.1 to 8.5, 9.1, 9.2, 10.1, 10.2)	9	CO3 CO4
4	<b>Cognitive Computing:</b> Concepts, Architecture, System and Application: Introduction, Cognitive Computing Architecture and approaches, Cognitive computing System and Applications. (Text2: Chapter 1)	9	CO5
5	<b>Cognitive Analytics:</b> Introduction, Evolution of Analytics and Core theme, Types of Learning, Cognitive Analytics applications. (Text2: Chapter 5)	9	CO6

#### **Text Books:**

- 1. Artificial Intelligence, E. Rich, K. Knight & S. B. Nair, 3rd edition, 2009, McGraw Hill.
- 2. Cognitive Computing: Theory and Applications, Vijay V. Raghavan, Venkat N. Gudivada, Venu Govindaraju, C.R. Rao, 2016, Elsevier.

#### **Reference books:**

1. Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norving, 2nd Edition, 2010, Pearson Education.

2. Introduction to Artificial Intelligence and Expert Systems, Dan W. Patterson, 1990, PHI.

3. Artificial Intelligence: Structures and Strategies for complex problem Solving, G. Luger, 4th Edition, 2002, Pearson Education.

4. Artificial Intelligence and Expert Systems Development, D. W. Rolston, 2002, McGraw hill.

5. Artificial Intelligence and Intelligent Systems, N. P. Padhy, 2015, Oxford University Press

-	PSO1	PSO2			
20ECE745A	Artificial Intelligence and Cognitive Computing				
CO1	3	2			
CO2	-	_			
CO3	3	2			
CO4	-	-			
C05	-	-			
CO6	3	2			

#### Mapping of CO v/s PSO:

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50Marks)

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

## SEE- Semester End Examination (50Marks)

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

#### **Software Defined Radio**

<b>Course Code</b>	: 20ECE746A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the concepts of software defined radio and its implementation issues
CO2	Apply the Multi rate signaling technique for sample rate conversion
CO3	Illustrate the various digital synthesis approaches
CO4	Examine the various data converter architectures and their performance
CO5	Analyze the basics of designing smart antenna systems to accommodate the needs
	of software defined radio
CO6	Make system level decisions for software defined radio technology and products

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

SYLLABUS							
Module No	Module Contents	Hrs	Cos				
1	<b>Introduction to SDR:</b> What is a Software Radio? The need for Software Radios, Characteristics and benefits of a Software Radio, Design principles of Software Radio. Text 1: 1.1,1.2,1.3,1.4 <b>Radio frequency implementation issues</b> . The purpose of the RF Front-End, Dynamic range: The principal challenge of receiver design. RF receiver front-end topologies, Enhanced flexibility of the RF Chain with Software Radios. Text 1: 2.1,2.2, 2.3, 2.4	9	CO1 CO6				
2	Importance of the components to Overall performance, Transmitter architectures and their Issues, noise and distortion in the RF Chain, ADC and DAC distortion. Text 1: 2.5,2.6, 2.7, 2.8 <b>Multirate signal processing-</b> Introduction to sample rate conversion principles, poly phase filters, digital filter banks, Text 1: 3.1, 3.2,3.3,3.4.	9	CO2 CO6				
3	<b>Digital generation of signals</b> . Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Spurious components due to periodic jitter, Bandpass signal generation, Performance of direct digital synthesis systems, Hybrid DDS-PLL Systems, Applications of direct digital synthesis, Generation of random sequences, ROM compression technique. Text 1: 4.1 To 4.11	9	CO3 CO6				
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4	Analog to digital and digital to analog conversion, Parameters of ideal data converters, Parameters of practical data converters, Techniques to improve data converter performance, Common ADC and DAC Architectures. Text 1: 5.1,5.2,5.3,5.4,5.5	9	CO4 CO6				
5	Smart antennas designing issues, Vector channel modelling, Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Diversity and space-time adaptive signal processing, Algorithms for transmit STAP, Hardware Implementation of smart antennas. Text 1: 6.1,6.2,.6.3,6.4,6.5,6.6,6.7,6.8	9	CO5 CO6				

### **Text Books:**

1. Jeffrey H Reed, Software Radio- A modern approach to radio engineering Prentice Hall PTR, 2002.

### **Reference books**:

1.Telecommunication Breakdown by C. Richard Johnson Jr., William A. Sethares, 2003, Prentice Hall.

2. Multi-carrier and Spread Spectrum Systems, K. Fazel, S. Kaiser, John Wiley and Sons, Ltd. Publication, 2010.

3. N.J. Fliege, "Multirate Signal Processing" John Wiley and Sons, 1994.

-	PSO1	PSO2			
20ECE746A	Software Defined Radio				
CO1	3	-			
CO2	-	-			
CO3	3	2			
CO4	3	2			
CO5	3	2			
CO6	3	2			

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50Marks)

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

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

### **Robotics**

<b>Course Code</b>	: 20ECE751A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Model the mathematical representation of robots' workspace		
CO2	Simplify the kinematics of robot manipulators		
CO3	Design of trajectory(s) for robot motion using joint space and cartesian space		
<b>CO</b> 4	Analyze the control mechanism in the design of a robot		
CO5	Make use of actuators, and controllers for robotic applications		
CO6	Identify the sensors for interfaces in industrial robots		

## Mapping of Course Outcomes to Graduate Attributes:

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

SYLLABUS					
Module no	Module Contents	Hrs	COs		
1	<b>Introduction:</b> History of robotics, Applications, Spatial descriptions and Transformations: Description of position and orientation: position vector, Rotation matrix; Mapping: translation and rotation, homogeneous transform; transformation arithmetic, transform equations, other forms of representation of orientation: Euler angles, 2 –vector representation, angle – axis representation, Euler parameters Text 01; Chapters: 1,2	9	CO1		
2	<b>Forward Kinematics:</b> Introduction, Link description, link connection description, Denavit Hartenberg parameters, Derivation of link transformations, concatenating link transformations, actuator space, joint space and Cartesian space <b>Inverse Kinematics:</b> Introduction, Solvability: existence of solution, multiple solutions and method of solution; algebraic vs. geometric approach, algebraic solution by reduction topolynomial, workspace, Repeatability and accuracy Text 01; Chapters: 3,4	9	CO2		
3	<b>Trajectory Generation</b> : Introduction, general considerations in path description and generation, Joint space schemes: cubic	9	CO3		

	polynomial, cubic polynomial for a path with via points, linear function with parabolic blends, linear function with parabolic blends for a path with via points, Cartesian space schemes: Cartesian straight-line motion, geometric problems with Cartesian paths, path generation at run time Text 01; Chapters: 7					
4	Linear Control: Feedback control, second order linear systems, control law portioning, trajectory following control, disturbance rejection and steady state error, continuous vs. discrete time control, modeling and control of a single joint, architecture of PUMA 560 robot controller Text 01; Chapters: 9 Actuators: Power conversion unit, Types of Actuators Text 02: Chapters: 7					
5	Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors Text 02; Chapters: 8	9	CO6			

### Case study:

Mandatory case study on a Robotic system specifying its block diagram and operation to be submitted as an assignment.

#### **Text Books:**

- 1. Introduction to robotics: mechanics and control, Craig J J, 3/E,Pearson Education India,2008.
- 2. Introduction to robotics: Analysis, systems, applications, Niku S B, Pearson Education,2008.

#### **Reference Books:**

- 1. Robotics: Fundamental concepts & analysis, Ghosal A, Oxford University Press, 2006
- 2. Craig. J. J. "Introduction to Robotics- mechanics and control", Addison- Wesley, 1999

-	PSO1	PSO2			
20ECE751A	Robotics				
CO1	3	2			
CO2	-	-			
CO3	-	-			
CO4	-	-			
CO5	-	-			
CO6	3	2			

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

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

**Note:** Any particular Robotic system can be considered as case-study for a team of students, and the teams are required to present the system's basic working principles to the class. This work can be considered as one of the assignments, which can be evaluated for 5 marks.

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

<b>Course Code</b>	: 20ECE752A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Examine the sources of power dissipation in CMOS circuits
CO2	Investigate the Impact of device and technology scaling on Low Power
	Electronics
CO3	Inspect different low power circuit techniques to design digital circuits
CO4	Distinguish various architectural techniques for minimizing power in SRAM
CO5	Analyze various energy recovery techniques in low power VLSI Design
CO6	Survey research articles on low power design methodologies in VLSI Design

	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12
C01	3	3	-	-	-	-	-	-	-	-	-	1
CO2	3	3	3	3	-	2	-	-	-	-	-	1
CO3	3	3	3	3	-	2	2	-	-	-	-	1
CO4	3	3	3	3	-	-	-	-	-	-	-	1
CO5	3	3	3	3	-	-	2	-	-	-	-	1
CO6	3	3	3	3	-	2	2	-	-	-	-	1

SYLLABUS								
Module No	Module Contents	Hrs	Cos					
1	Introduction to Low Power CMOS VLSI Design: Motivation, Needs for Low Power VLSI Chips, Sources of Dissipation in digital integrated circuits, Degrees of freedom, Recurring themes in Low Power, Emerging Low power approaches-an overview. TEXT1:(1.1, 1.2, 1.3, 1.4, 1.5)	9	CO1					
2	<b>Device and Technology Impact on Low Power</b> <b>Electronics: in</b> troduction, dynamic dissipation in CMOS, Effects of and on Speed, Constraints on reduction, Transistor sizing and Optimal Gate oxide thickness, impact of technology scaling, Technology and device innovations. TEXT1:(2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7)	9	CO2					

3	<b>Low Power Circuit Techniques:</b> Introduction, Power Consumption in Circuits, Flip Flops and latches, Logic, High Capacitance Nodes. TEXT1:(3.1, 3.2, 3.3, 3.4, 3.5)	9	CO3
4	<b>Low-Power Static RAM Architectures:</b> Introduction, Organization of a static RAM, MOS static RAM memory cell, Banked Organization of SRAMs, Reducing Voltage swings on Bit Lines, Reducing Power in the write driver circuits, Reducing Power in Sense Amplifier Circuits, Method for Achieving Low Core Voltages from a single supply. TEXT2:(6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8)	9	CO4
5	<b>Low- Energy Computing Using Energy Recovery</b> <b>techniques:</b> Energy Dissipation in Transistor Channel Using an RC Model, Energy Recovery Circuit Design, Designs with Partially Reversible Logic, Supply Clock Generation. TEXT2:(7.1, 7.2, 7.3, 7.4)	9	CO5 CO6

- 1. Low Power Design Methodologies, Jan M. Rabaey, Massoud Pedram, 2<sup>nd</sup> edition 2014, Springer Science + Business Media, LLC.
- 2. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, 2015, Wiley India Pvt.Ltd
- Practical Low Power Digital Low Power VLSI Design, Gary Yeap, 4<sup>th</sup> edition, 2014, Springer International Edition.

### **REFERENCE BOOKS**:

1. CMOS VLSI Design: A circuits and systems perspective, Neil H.E. Weste, David Harris, 4<sup>th</sup> Edition, 2015, Pearson.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2				
20ECE752A	Low Power VLSI Design					
CO1	-	-				
CO2	2	2				
CO3	2	2				
CO4	2	2				
CO5	2	2				
CO6	2	2				

## **Assessment Pattern**

## CIE- Continuous Internal Evaluation (50 Marks)

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

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

### Wireless Ad-Hoc Sensor Networks

Course Code: 20ECE753A	Credits	:3
L: T:P:S : 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours : 3 Hrs	SEE Marks	: 50

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

CO1	Understand the architecture and application of ad-hoc and wireless sensor networks
CO2	Classify MAC protocols of Ad Hoc Networks
CO3	Evaluate various routing protocols of Ad Hoc Networks and WSN
CO4	Discuss the design principles and services of WSN
CO5	Examine the packet delivery process in WSN over transport layer
CO6	Comprehend the issues and challenges in Ad Hoc Networks and WSN design

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

SYLLABUS							
Module No	Module Contents	Hours	COs				
1	Introduction to AD Hoc Networks Ad Hoc Networks, Differences between Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, Technical and Research Challenges, Issues in Ad Hoc Wireless Networks. Text Book 1: 1.3.1, 1.3.2, 1.3.3, 1.3.4	9	CO1				
2	MAC Layer Protocols for Ad Hoc Wireless Networks Important Issues and the Need for Medium Access Control (MAC) Protocols, Classification of MAC Protocols- Contention-Based MAC Protocols, Contention-Based MAC Protocols with Reservation Mechanisms, Multiple-Channel MAC Protocols. Text Book 1: 2.2, 2.3.1, 2.3.2, 2.3.4	9	CO2				
3	Routing Protocols and Network Security Ad Hoc Wireless Networks Design Issues of Routing Protocols for Ad Hoc Networks, Proactive Routing Protocols- Wireless Routing Protocol (WRP), Reactive Routing Protocols- Dynamic Source Routing (DSR)	9	CO3				

	Protocol, Hybrid Routing Protocols- Zone Routing Protocol (ZRP)		
	Text Book 1: 3.2, 3.4.1, 3.5.2, 3.6.1		
	Architecture and Design Principles of WSN		
	Challenges for WSNs, Difference between WSN and MANET,		
	Single-node architecture- Hardware components, Energy		CO1
4	consumption of sensor nodes, Sensor network scenarios,	9	CO1,
	Optimization goals and figures of merit, Design principles for		
	WSNs, Service interfaces of WSNs		
	Text Book 2 : 1.4, 1.5, 2.1, 2.2, 3.1, 3.2 3.3, 3.4		
	<b>Routing protocols and Transport layer in WSN</b>		
	Gossiping and agent-based unicast forwarding, Energy-efficient		
5	unicast, Broadcast and multicast, Geographic routing, The	0	СОЗ,
	transport layer and QoS in wireless sensor networks, Single packet	9	CO5
	delivery, Block delivery		
	Text Book 2 : 11.2, 11.3, 11.4, 11.5, 13.1, 13.4, 13.5		

- 1. Subir Kumar Sarkar, T G Basavaraju," Ad Hoc Mobile Wireless Networks, Principles, Protocols and Applications", Auerbach Publications, Taylor and Francis, London, 2008
- 2. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005

#### **REFERENCE BOOKS**:

- 1. W Dargie and C Poellabauer, "Wireless Sensor Networks: Theory and Practice", 1<sup>st</sup> Edition, Wiley India Pvt. Ltd., New Delhi, India, 2012.
- 2. Kazem Sohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-Technology, Protocols, and Applications", John Wiley, 2007.
- 3. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
- 4. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication 2002.

-	PSO1	PSO2
20ECE753A	Wireless Ad-H	loc Sensor Networks
CO1	-	-
CO2	-	-
CO3	2	2
CO4	2	2
CO5	-	-
CO6	2	2

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation Theory (50 Marks)

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

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

## VLSI Signal Processing

<b>Course Code</b>	: 20ECE754A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the concepts of DSP and Low power VLSI signal Processing
CO2	Use of transformation technique like retiming to improve system efficiency and optimization
CO3	Illustrate the use of various DSP algorithms for VLSI processing
CO4	Use pipelining and parallel processing in design of high-speed /low-power applications
CO5	Apply the Arithmetic Architecture and its applications to improve overall System efficiency.
CO6	Evaluate the use of look-ahead techniques in parallel and pipelined IIR Digital filters

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

SYLLABUS					
Module No	Module Contents	Hours	COs		
1	Introduction to DSP Systems & Low power Design Introduction to DSP Systems -Typical DSP algorithms; Iteration Bound – data flow graph representations, loop bound and iteration bound, Low power Design – needs for low power VLSI chips, charging and discharging capacitance, short-circuit current of an inverter, CMOS leakage current, Static Current, basic principles of low power design & Low Power Figure of Merits Text-1: 1.1,1.2, 2.1,2.2,2.3 Text 2: 1.1,1.2,1.3,1.4,1.5,1.6, 1.7	9	CO1		
2	<b>Retiming:</b> Retiming - definitions and properties; Unfolding – algorithm for Unfolding, properties of unfolding, DCT algorithm architecture transformation, parallel architectures for rank-order filters, Odd- Even Merge- Sort architecture, parallel	9	CO2		

	rank-order filters.		
	Data Correlation Analysis in DSP Systems		
	Text-1: 4.1, 4.2, 4.3, 5.1, 5.2, 5.3, 9.1, 9.2, 9.3, 9.4, 9.5		
	Text 2: 2.5		
3	<b>Fast Convolution &amp; Advanced Techniques in Low power</b> <b>designs:</b> Fast convolution – Cook-Toom algorithm, modified Cook-Took algorithm; Pipelined and parallel recursive and adaptive filters – inefficient/efficient single channel interleaving, Look A head pipelining in first- order IIR filters, Look-Ahead pipelining with power-of-two decomposition, Clustered Look-Ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters, pipelined adaptive digital filters, relaxed look-ahead, pipelined LMS adaptive filter. <b>Adiabatic Computation, Pass Transistor Logic Synthesis,</b> <b>Asynchronous Circuits</b> Text-1: 8.1,8.2,10.1,10.2,10.3,10.4,10.5,10.6,10.8 <b>Text2: 8.1 – 8.3</b>	9	CO3, CO4
4	<b>Bit-Level Arithmetic Architectures&amp; System</b> Scaling and Round Off Noise, State Variable Description of Digital Filters, Scaling and Round off Noise Computation, Round Off Noise in Pipelined IIR Filter. Bit Level Arithmetic Architecture Power and Performance Management, Switching Activity Reduction, Parallel Architecture with Voltage Reduction, Flow Graph Transformation Text-1: 11.1,11.2,11.3,11.4,11.5,13.1,13.2,13.3,13.4,13.5,13.6,13.7 <b>Text 2: 7.1 - 7.4</b>	9	CO4, CO5
5	<b>Programming Digital Signal Processors:</b> Numerical Strength Reduction – sub expression elimination, multiple constant multiplications, iterative matching. Linear transformations; Synchronous, Wave and asynchronous pipelining synchronous pipelining and clocking styles, clock skew in edge-triggered single-phase clocking, two-phase clocking, wave pipelining, asynchronous pipelining bundled data versus dual rail protocol; Programming: Digital Signal Processors – general architecture with important features. Text1- 15.1,15.2,15.3,16.1,16.2,16.3,16.4,16.5,16.6,16.7,18.1,18.2,18.3	9	CO6

- 1. VLSI Digital Signal Processing systems, Design and implementation, Keshab K.Parhi, Wiley, Inter Science, 2007
- 2. Practical Low Power Digital VLSI Design, Gary Yeap, Kluwer Academic Publishers, 1998.

### **REFERENCE BOOKS**:

- 1. Analog VLSI Signal and Information Processing, Mohammed Ismail and Terri Fiez, Mc Graw-Hill, 1994.
- 2. VLSI and Modern Signal Processing, S.Y. Kung, H.J. White House, T. Kailath, Prentice Hall, 1985.
- 3. Design of Analog & Digital VLSI Circuits for Telecommunication and Signal Processing, Jose E. France, Yannis Tsividis, Prentice Hall, 1994.
- 4. CMOS Analog Circuit Design, Phillip E Allen, Douglas R Holberg, OUP USA, 3<sup>rd</sup> Edition, 2012

-	PSO1	PSO2		
20ECE754A	VLSI Signal Processing			
CO1	-	-		
CO2	3	2		
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	-	-	-

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

### Neural Networks

<b>Course Code</b>	: 20ECE755A	Credits	:3
L: T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the neural network and relate how to model equivalent neuron models					
CO2	Examine different learning algorithms for single layer and multilayer perceptron's					
CO3	Analyse different neural network models for feed forward and feedback networks					
CO4	Explore the application of SVM and RBF in modelling neural networks					
CO5	Investigate various competitive learning network architectures for complex pattern					
005	recognition tasks					
<b>CO6</b>	Identify and execute engineering applications based on neural networks					

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

SYLLABUS							
Module No.	Module Contents	Hours	COs				
1	Introduction: What is a neural network? Human brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Characteristics of Neural Networks, Historical Development of Neural Networks, Principles, Network Architectures, Knowledge Representation, Hebbian learning, Competitive learning, Boltzmann learning, memory-based learning. Text 1: Chapter-1,8	9	CO1				
2	<b>Single layer and multilayer perceptron's:</b> Introduction, adaptive filtering problem, linear least square filters, least mean square algorithm, perceptron convergence theorem, relation between perceptron and Bayes classifier for a Gaussian environment, back propagation algorithm, XOR problem, feature detection Text 1: Chapter- 3,4	9	CO2				
3	<b>Feed forward Neural Networks:</b> Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of Pattern Mapping Networks, Analysis of Linear Auto associative FF Networks.	9	CO3, CO6				

	Feedback Neural Networks: Introduction, Analysis of Pattern Storage Networks, Boltzmann Machine Text 1: Chapter- 4,5,11 Text 2: Chapter- 4		
4	Support Vector Machines and Radial Basis Function: Introduction, how to build a support vector machine for pattern recognition, example, SVM for nonlinear regression, Radial Basis Function, Regularization theory, Generalized RBF Networks, approximation properties of RBF networks, comparison of RBF networks and multilayer perceptron's. Text 1: Chapter – 5,6	9	CO4, CO6
5	Competitive Learning Neural Networks & architectures for Complex pattern Recognition tasks: Introduction, components of competitive learning networks, Analysis of Pattern Clustering Networks, Analysis of Feature Mapping Networks, Associative Memory, pattern mapping, temporal patterns. Text 2: Chapter- 4,9	9	CO5, CO6

- 1. Neural Networks: A comprehensive foundation, Simon Haykin 3<sup>rd</sup> edition, Pearson education, 2016.
- 2. Artificial Neural Networks: B. Yagna Narayana, PHI, 2004

### **REFERENCE BOOKS**:

- 1. Neural networks: algorithms, applications and programming techniques, James A. Freeman, David M. Skapura, Pearson Education, 2002.
- 2. Introduction to artificial neural systems, Jacek M. Zurada, Jaico publishing house, 1994.
- 3. Deep Learning Essentials, Wei Di, Anurag Bhardwaj, Jianing Wei, Packt publishing Ltd. 2018

-	PSO1	PSO2
20ECE755A	Nei	ıral Networks
CO1	-	-
CO2	3	2
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
Marks (out of 50)	25	15	10
Remember		-	5
Understand	5	5	-
Apply	10	5	5
Analyze	10	5	-
Evaluate	-	-	-
Create	-	-	-

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

## **Renewable Energy**

Course Code : 20ECE756A L: T:P:S : 3:0:0:0 Exam Hours : 3 Hrs Credits: 3CIE Marks: 50SEE Marks: 50

**Course Outcomes: On completion of the course, students should be able to:** 

CO1	Categorize the sources and features of energy and discuss its impact			
CO2	Examine the traditional energy systems in present context			
CO3	Analyze the technologies and applications associated with Solar Energy systems			
<b>CO4</b>	Appraise the operating principle of sustainable renewable energy systems			
CO5	Estimate the Life Cycle Costing of sustainable hybrid energy systems			
CO6	Engage in independent study as a member of a team and make an effective oral presentation on the applications of renewable energy concepts			

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12
C01	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	3	3	-	-
CO3	3	3	3	3	-	3	3	-	3	3	-	3
<b>CO4</b>	3	3	3	3	-	3	3	-	-	3	-	3
CO5	3	3	3	-	-	3	3	-	3	-	3	3
CO6	3	3	3	3	-	3	3	-	3	3		3

SYLLABUS						
Module. No	Module Contents	Hours	COs			
1	<ul> <li>Introduction: Energy usage by Human-Estimate of Impact on atmosphere, Fossil fuel-based systems and its impact on society.</li> <li>Renewable Energy: Sources and features, Hybrid energy systems and Distributed energy systems. Current energy scenario of India and world.</li> <li>Reference: 1,2,3</li> </ul>	9	CO1			
2	<b>Traditional Energy Systems:</b> Sources, Features and Characteristics. <b>Applications:</b> Transport – bullock cart, horse carriage, camels; Agriculture – ox plough, water lifting devices; Human power – bicycle, cycle rickshaw etc.; House hold – cooking (bio mass), lighting etc. Reference:2, 3, 5	9	CO2, CO6			
3	<ul> <li>Solar Thermal Systems: Solar radiation spectrum. Radiation measurement, Technologies. Applications: Heating, Cooling, Drying, Distillation, Power generation.</li> <li>Solar Photovoltaic Systems: Operating principles and its concept, Cell, Module, Array, Series and parallel connections, Maximum power point tracking. Applications: Battery charging, Pumping, Lighting and Peltier cooling.</li> <li>Case Study: "<i>Rural electrification programme</i>" Text-1: 1.1, 1.2, 2.1-2.3,3.1-3.4,8.1-8.3,8.6; Reference-1</li> </ul>	9	CO3,CO6			
4	<ul> <li>Micro-hydel: Operating principles, Components of a micro-hydel power plant, Types, characteristics of turbines and Turbine Selection.</li> <li>Wind: Operating principle, Site selection, Types of windmills, and characteristics of wind generators</li> <li>Biomass: Combustion, Biomass gasifier and Wood gasifier Applications: Biogas, Wood stoves and Bio diesel.</li> <li>Wave Energy: Operating principle, Power associated with sea waves, devices for harnessing wave energy.</li> <li>Case study: "Biomass gasifier for electrification" Text-1:9.1,9.2,9.3,9.4;</li> <li>Text2:6.1,6.2,6.5.2,6.7,6.8,6.11,12.1,12.2,12.3,12.5;</li> <li>Reference-1</li> </ul>	9	CO4, CO6			
5	Hybrid Systems and Costing: Need for Hybrid Systems. Range and type of Hybrid systems. Study of Diesel-PV, Wind-PV, Micro-hydel-PV, Biomass-Diesel systems, electric and hybrid electric vehicles Costing: Life cycle costing (LCC). Solar thermal system LCC. Solar PV system LCC. Micro-hydel LCC. Wind system LCC. Biomass system LCC. Reference 3, 4- chapter 7.4	9	CO5			

### **Text Books**

- 1. Solar Energy, S. P. Sukhatme and J. K. Nayak, Mc Graw Hill Education, Fourth edition, 2017
- 2. Non-conventional energy resources, Shobh Nath Singh, Pearson India, 2015.

#### **Reference Books/Materials:**

- 1. NPTEL Lecture material on Non-Conventional Energy Sources by Dr.Haridoss, IIT Madras.
- 2. "Energy Technologies and Economics", Springer, Chapter Fossil Energy Systems, pp 51-120.
- 3. Learning Material NCES-renewable energy by L.Umaanand, IISc, Bangalore.
- 4. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning, Academic Press, 5th Edition 2017.
- 5. Rural Energy System(RDL 722)-Animal Energy and its application-IIT Bombay.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2		
20ECE756A	Renewable Energy			
CO1	-	-		
CO2	-	-		
CO3	3	2		
CO4	3	2		
CO5	3	2		
<b>CO6</b>	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	5	5	5
Analyze	10	5	
Evaluate	5	5	
Create			

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

### **Advanced Communication Lab**

<b>Course Code</b>	: 20ECL76A	Credits	: 1.5
L: T: P:S	: 0:0:1.5:0	<b>CIE Marks</b>	: 25
Exam Hours	: 3 Hrs	SEE Marks	: 25

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

CO1	Analyze the functionality of different blocks in Communication Trainer boards
CO2	Model a satellite communication system based on link budget
CO3	Demonstrate the working of a spectrum analyzer
CO4	Implement the various models of radio signal propagation mechanisms
CO5	Simulate digital modulation schemes
CO6	Simulate modern communication techniques

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

Sl. No.	LIST OF EXPERIMENTS	COs
1	Study of basic operation of a spectrum analyzer.	CO3
2	Simulation of Okumura, HATA models using MATLAB.	CO4
3	Simulation of log-normal shadowing models using MATLAB.	CO4
4	Study of CDMA (DS-SS) technique using analog signal as an input signal (trainer kit based).	CO1
5	Study and identify different blocks of mobile phone unit and sketch the waveforms of different sections, measure voltages at various test points in Mobile Communication Trainer board.	CO1, CO3
6	Simulation of OFDM transmitter and receiver using MATLAB.	CO5, CO6
7	Simulation of MIMO system using MATLAB.	CO5, CO6
8	To write a MATLAB program to calculate the link budget for satellite communication.	CO2

9	To write a MATLAB program to calculate the Carrier to noise ratio for uplink and downlink and also the overall carrier to noise ratio.	CO2
10	To Generate & detect QPSK using MATLAB.	CO5
11	To Generate & detect BFSK using MATLAB.	CO5
12	To Generate & detect Delta Modulation using MATLAB.	<b>CO5</b>

-	PSO1	PSO2
20ECL76A	Advanced	Communication Lab
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
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	-	_

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

## EDA Software Workshop Lab

<b>Course Code</b>	: 20ECL77A	Credits	: 1.5
L: T: P:S	: 0:0:1.5:0	<b>CIE Marks</b>	: 25
Exam Hours	: 3 Hrs	SEE Marks	:25

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

CO1	Use the different freeware for circuit simulation and analysis
CO2	Employ the available freeware for designing Printed Circuit Boards
CO3	Program the embedded system designs using the available freeware
CO4	Develop solutions to the industry needs, by using the embedded designs
CO5	Verify the functionality of various analog and digital VLSI circuits using the freeware
CO6	Perform the layout design for the simulated VLSI circuitry

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

SI. No.	LIST OF EXPERIMENTS	COs
1	<ul> <li>Proteus : Proteus combines powerful features with ease of use to help electronics engineers design, test, and lay out professional PCBs incredibly quickly and easily. Proteus is intuitive and includes a world-class shape-based autorouter, making it a complete software design tool for modern engineers.</li> <li>Nearly 800 microcontroller variants ready for simulation right from the schematic</li> <li>Professional PCB layout package</li> <li>Combines schematic capture and ARES PCB layout programs to be a powerful, integrated suite of tools for professional PCB design</li> </ul>	C01, C02
2	<b>Atmel Studio:</b> Studio includes Atmel Gallery, an online app store that allows you to extend your development environment with plug-ins developed by Microchip as well as third-party tool and embedded software vendors. Studio 7 can also seamlessly import your Arduino sketches as C++ projects, providing a simple transition path from Makerspace to Marketplace.	CO3, CO4

3	<b>Tanner:</b> T-Spice simulator, part of the Tanner Tool Suite, integrates easily with other design tools in the flow and is compatible with industry-leading standards. It improves simulation accuracy with advanced modeling, multi-threading support, device-state plotting, real-time waveform viewing, and analysis, and a command wizard for simple SPICE syntax creation.	CO5, CO6
4	<ul> <li>Ultiboard: National Instruments accelerates engineering success with their open, software-centric platform that leverages modular hardware and an expansive ecosystem.</li> <li>Seamless integration with Multisim</li> <li>Saves electronics engineers hours of development time</li> <li>Complete circuit schematics, SPICE simulation, and PCB layout in the same environment</li> </ul>	CO1, CO2
5	<b>Uvision Keil:</b> Arm Keil MDK is the most comprehensive software development solution for Arm-based microcontrollers and includes all components that you need to create, build, and debug embedded applications.	CO3, CO4
6	<b>Electric:</b> It is one of the highly efficient options for VLSI simulation and layout. This very-large-scale-integration (VLSI) tool lets you draw schematics and create integrated circuit (IC) layouts digitally. Electric 9.07 is also compatible with hardware description languages like VHDL and Verilog.	CO5, CO6

-	PSO1	PSO2
20ECL77A	EDA Soft	ware Workshop Lab
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
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	-	-

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

Project Phase- 1					
<b>Course Code</b>	20ECL78A	Credits	02		
L: T: P: S	0:0:2:0	<b>CIE Marks</b>	25		
<b>Exam Hours</b>	03	SEE Marks	25		

	Course outcomes
	Engage in independent study to review literature in identified domain
C01	
CO2	Ability to consolidate the literature search to identify and formulate the engineering problem
02	
	Identify the community that shall benefit through the solution and also create awareness for eco friendly
CO3	environment through prescribed standards/safety norms
	Ability to engage in independent study to arrive at an exhaustive list of available engineering tools that
<b>CO4</b>	may be used for solving the identified engineering problem
	indy de used for softing the identified engineering problem
	Ability to prepare the Gantt Chart for scheduling the project work and designate responsibility of every
CO5	member in the team
	Engage in effective written and oral communication through project report/viva voce
C06	

## Mapping of Course Outcomes to Program Outcomes:

СО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	-	-	-	3	-	-	-	-	-	-	-	3	3	3
CO3	-	-	-	-	-	3	3	-	-	-	-	-	-	-
C04	-	-	-	-	3	-	-	-	-	-	-	-	-	-
C05	-	-	-	-	-	-	-	-	3	-	-	-	-	-
C06	-	-	-	-	-	-	-	-	-	3	-	-	-	-

## **CIE - Continuous Internal Evaluation (25)**

<b>Bloom's Taxonomy</b>	Project Phase - 1
Marks (Out of 25)	-
Remember	-
Understand	-
Apply	10
Analyze	10
Evaluate	5
Create	-

## **SEE – Semester End Examination (25)**

<b>Bloom's Taxonomy</b>	Project Phase - 1
Remember	-
Understand	-
Apply	10
Analyze	10
Evaluate	5
Create	-

### **CISCO - ROUTING AND SWITCHING-I**

<b>Course Code</b>	: 20NHOP709	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							
05	networks.							
COA	Configure and troubleshoot advanced operations of routers and implement							
04	Link State routing protocols (OSPF).							
CO5	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking							
03	protocol.							
CO6	Examine redundancy using Spanning tree protocols and Ether-Channel for network scalability							
	network sediaonity							

	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	<ul> <li>Layered Architecture: Layered Architecture and protocols, Network Devices: Switches, Routers, NIC, Access Points, Modem.</li> <li>Topologies: Mesh Topology, Star Topology, Bus Topology, Ring Topology, Hybrid Topology.</li> <li><u>HANDS-ON</u> <ol> <li>Basic Router Configuration: Configure Initial Router Settings, Configure Interfaces, Configure the Default Gateway, Ping and Traceroute Testing</li> <li>SSH Configuration and verify the secure access to the network device.</li> </ol> </li> </ul>	8	CO1

2	<ul> <li>IPv4 Addressing:IPv4 Address Structure, IPv4 Unicast, Broadcast, and Multicast, Types of IPv4 Addresses, Subnetting concept</li> <li>DHCPv4: DHCP4 Concepts Configure a Cisco IOS DHCP4 Server; Configure a DHCP4 Client</li> </ul>		
	<ul> <li>IPv6 Addressing:IPv6 Address Representation, IPv6 Address Types,</li> <li>SLAAC and DHCPv6: IPv6 Global Unicast Address Assignment, SLAAC, DHCPv6</li> </ul>	8	CO2, CO3
	HANDS-ON1. DHCPv4 Configuration2. DHCPv6 Configuration		
3	Routing Concepts: Path Determination, Packet Forwarding, IP Routing Table, Dynamic Routing, Default Static RouteSingle-AreaOSPFConcepts:OSPFFeaturesandCharacteristics, OSPF Packets, OSPF Operation,	8	CO4
	<b>HANDS-ON</b> <ol> <li>Configure IP Default Static Routes</li> <li>Single-Area OSPFv2 Configuration</li> </ol>		
4	<ul> <li>VLANS: Overview of VLANs, VLAN Configuration, VLAN Trunks, Dynamic Trunking Protocol, Inter VLAN routing</li> <li><u>HANDS-ON</u> <ol> <li>VLAN Configuration</li> <li>Inter-VLAN routing Configuration</li> </ol> </li> </ul>	8	CO5
	<b>Spanning Tree Protocol:</b> Purpose of STP,STP Operations, Evolution of STP,RSTP,RSTP+		
5	EtherChannel: EtherChannel Operation, LACP, PAGP, <u>HANDS-ON</u> 1. Spanning Tree Protocol Configuration         2. EtherChannel Configuration	8	CO6

- CISCO Netacad (ONLINE ACCESS)
   CCNA Routing and Switching Todd Lammle, 2<sup>nd</sup> Edition, Sybex Publisher (Wiley Brand), 2016.

## **REFERENCE BOOKS**:

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

## **Assessment Pattern**

## CIE- Continuous Internal Evaluation (50 Marks)

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

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

### **CISCO - ROUTING AND SWITCHING-II**

<b>Course Code</b>	: 20NHOP712	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	Configure advanced operation of ACL and implement extended ACL for IPv4 and IPv6
CO2	Configure Network address translation (NAT) for IPv4
CO3	Configurea secured Wireless LAN setupusing Routers and extend wireless connectivity using Access Points
CO4	Examine the operations of WAN, WAN Authentication Protocols and best practices for network security
CO5	Examine the operation of virtual private network (VPN) and concepts of network automation and virtualization
CO6	Evaluate the network configurations, identify the errors and configure correctly for effective network communication for lifelong learning

## 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	-	2	-	-	3	-	3
CO3	3	3	3	3	3	2	2	-	-	3	-	3
CO4	3	3	3	3	3	2	2	2	2	3	2	3
CO5	3	3	3	3	3	2	2	-	2	3	2	3
CO6	3	3	3	3	3	2	2	2	2	3	2	3

Mapping of CO v/s PSO:

СО	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	3
CO5	3	3
CO6	-	3

Module No	Module Contents	Hours	COs
1	ACL Concepts:Overview of ACL operation, Guidelines for ACL Creation, Comparison of Standard and Extended ACLs, Implementation of Extended ACLs, Troubleshoot Scenarios. (NETACAD-Course ENSA- Chapter 4 & 5.3, 5.4 Chapters ), <u>HANDS-ON</u> 1. Configure Extended IPv4 ACLs and its comparison with Standard ACLs	8	CO1, CO6
2	<ul> <li>NAT for IPv4: NAT Characteristics, Types of NAT, NAT Advantages and Disadvantages, Static NAT, Dynamic NAT, PAT, Troubleshoot Scenarios.(NETACAD-Course ENSA- Chapter 6)</li> <li><u>HANDS-ON</u></li> <li>1. Configure Static NAT</li> <li>2. Configure Dynamic NAT</li> </ul>	8	CO2,CO6
3	WLAN Concepts: Introduction to Wireless, Components of WLANs, WLAN Operation, Channel Management, Securing WLANs(NETACAD - Course SRWEChapter 12 & Chapter 13) <u>HANDS-ON</u> 1. Remote Site WLAN Configuration(Wireless Router)         2. Configure a Basic WLAN on the WLC	8	СО3
4	<ul> <li>WAN Concepts: Purpose of WANs ,WAN Operations, (NETACAD-Course ENSA- Chapter 7)</li> <li>Network Security Concepts : Threat Actors, Malware, Common Network Attacks, IP Vulnerabilities and Threats, TCP and UDP Vulnerabilities, (NETACAD-Course ENSA-Chapter 3)</li> <li><u>HANDS-ON</u></li> <li>1.Configuration of WAN Point to Point Protocol (PPP) using Password Authentication Protocol (PAP).</li> <li>2. Configuration of WAN Point to Point Protocol (PPP) using Challenge Handshake Authentication Protocol (CHAP).</li> </ul>	8	CO4
5	Virtual Private Network: VPN and IPsec Concepts: VPN Technology, Types of VPNs, (NETACAD-Course ENSA- Chapter 8) Network Automation and Virtualization:Data Formats, APIs, REST, Configuration Management Tools, Virtualization, Software-Defined Network. (NETACAD- Course ENSA-Chapter 13 &14) <u>HANDS-ON</u> 1. Configuration of VPN using GRE	8	CO5

- 1. CISCO Netacad Course-3 : CCNAv7-Enterprise Network, Security and
- Automation(ONLINE ACCESS) 2. CCNA Routing and Switching Todd Lammle, 2<sup>nd</sup> Edition, Sybex Publisher (Wiley Brand), 2016.

#### **REFERENCE BOOKS:**

- 1. Data Communications and Networking. Forouzan, 5<sup>th</sup> Edition, McGraw Hill, Reprint-2017.
- 2. CISCO Netacad Course-2 : CCNAv7-Switching, Routing and Wireless Essentials (ONLINE ACCESS)

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

<b>Bloom's Taxonomy</b>	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	-	-	-
Understand	-	-	5
Apply	10	10	5
Analyze	10	5	-
Evaluate	05	-	-
Create	-	-	-

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

### PHYSICAL DESIGN

Course Code : 20NHOP718A 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	Understand VLSI Technology back-end design flow and its implementations
CO2	Apply the procedure of Floor planning in Physical Design
CO3	Use the placement algorithms in Physical Design
CO4	Examine routing and Design Rule Check for a given Physical Design
CO5	Evaluate clock tree synthesis and power management of the circuit
CO6	Engage in independent learning and perform the Physical Design of selected VLSI circuit

## Mapping of Course Outcomes to Program Outcomes:

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

Correlationlevels:1-Slight (Low)

2-Moderate (Medium) 3-Substantial (High)

Module No	Module Contents	Hours	COs
1	<b>Introduction to Physical Design</b> Introduction to PD flow, Inputs of PD – Library files, Netlist, SDC(Synopsis Design Constraints), LEF(Library Exchange File),Output of PD – GDSII, Area, Power, Timing reports.	08	CO1,CO6
2	Partitioning and Floor planning Partitioning, Floorplanning, Pin Assignment, Floor plan-Die size estimation, Aspect Ratio, Core Utilization, Macros and Types –Soft macros, Hard macros, Firmmacros	08	CO2,CO6

	Placement		
3	Type of Placement – Standard cell placement, Building block placement Cell types – Well tap cells, End cap cells, Decap cells, Filler cells, Spare cells, Timing driven placement, Congestion driven placement, Placement Congestion – Global route congestion, Congestion map, Easing congestion	08	CO3,CO6
4	<b>Routing</b> Routing types, Design Rule check, clock route vs signal route, shorts, opens, Getting attributes like route length, number of viasetc for a given net	08	CO4,CO6
5	Power plan – Rings, Stripes, Rails, Core power management, I/O cell power management, IR drop – types of IR drop Skew, Latency, Jitter, Useful skew, Hold fixing func mode and shift mode, Generated clocks, clock groups vs false paths, clock routing	08	CO5,CO6

- 1. VLSI physical design automation : theory and practiceby Sadiq M Sait and Habib Yusuf, McGraw-Hill BookCo.
- 2. VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu2011, Springer.

#### **REFERENCE BOOKS:**

- 1. J. Bhasker, R Chadha,., "Static Timing Analysis for Nanometer Designs: A Practical Approach", Springer, 2009.
- 2. Michael John Sebastian Smith, "Application Specific Integrated Circuits" Addison Wesley Professional;2005.

-	PSO1	PSO2	
20NHOP718A	Physical Design		
CO1	-	-	
CO2	3	3	
CO3	3	3	
CO4	3	3	
CO5	3	3	
CO6	3	3	

Mapping of CO v/s PSO:

## **Assessment Pattern**

# CIE- Continuous Internal Evaluation (50 Marks)

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

Bloom's Taxonomy	SEE Marks					
Remember	-					
Understand	-					
Apply	20					
Analyze	15					
Evaluate	15					
Create	-					
PROGRAMMING OF INDUSTRIAL ROBOT						
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Course Code: 20NHOP722A	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

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12
20NHOP722A			PRO	GRAN	1MINO	G OF I	NDUS	TRIAI	ROB	OT	1	1
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	Module Contents	Hours	COs
No			
1	<ul> <li>BASICS OF ROBOTICS</li> <li>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.</li> </ul>	08	CO1
2	<ul> <li>ROBOT TEACHING <ul> <li>Teach pendant programming: Various Teaching Methods, Task Programming, Motion Interpolation.</li> <li><i>Hands on:</i></li> <li>i. Explanation on tool Orienting</li> <li>ii. Selection &amp; Creation of Teach program</li> <li>iii. Explanation on Joint, Linear &amp; Circular motion</li> <li>iv. Program testing, editing &amp;Touch up</li> <li>v. Using and setting up of User frame</li> <li>vi. Using and setting up of Tool Frame</li> </ul> </li> </ul>	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

	INDUSTRIAL APPLICATIONS OF ROBOTS		
4	<ul> <li>Robot Application: Implementation of robots in industries Various steps, Machine loading/unloading. Assembly and Inspection, Feature Application, Material handling Applications – PICK and PLACE &amp; Palletization, Robot cycle time analysis</li> <li><i>Hands on:</i> <ol> <li>Practice on Pick and Place application</li> <li>Practice on Palletization</li> </ol> </li> </ul>	08	CO4, CO6
	iii. Practice on real time applications		
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:         Iterach verification         i. reach verification         ii. collision detection         iii. collision detection         iii. collision detection         iii. 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.

CO	PSO1	PSO2					
20NHOP722A	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)

<b>Bloom's Taxonomy</b>	SEE
	Mark s
Remember	-
Understand	5
Apply	30
Analyze	5
Evaluate	5
Create	5

5G MOBILE COMMUNICATION						
Course Code : 20NHOP723A	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
20NHOP723A					5G M	OBILE	COM	MUNIC	CATIO	N		
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
C05	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
	<b>5G RADIO SPECTRUM:</b> 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies.		
1	<b>5G CHANNEL MODEL</b> : The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling.	8	CO1, CO4
	<b>5G USE CASES AND SYSTEM CONCEPT:</b> 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		
	<b>RADIO INTERFACE ARCHITECTURE:</b> 5G architecture options, core network architecture, RAN architecture.		
2	<b>5G PHYSICAL LAYER:</b> Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).	8	CO2
	Textbook 3: 5.1,5.2,5.3,5.4, 6.3,6.4,6.11,6.12		
3	<b>5G RADIO-ACCESS TECHNOLOGIES:</b> Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access	8	CO3, CO4
	Textbook 1: 7.1,7.2,7.3		
	<b>INTRODUCTION TO 5G NETWORK SLICING</b> : Network Slicing, E2E Slicing, SDN and NFV Slicing		<b>CO</b> 4
4	<b>VEHICULAR COMMUNICATIONS:</b> From V2V to AV2X, key standards, VC architectures, V2X Use cases	8	CO4, CO5
	Textbook 2: 5.7		
5	<b>MOBILITY AND HANDOFF MANAGEMENT IN 5G:</b> Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G.	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:**

- Gordon L. Stuber, "Principles of Mobile Communication", KLUWER ACADEMIC PUBLISHERS, 2<sup>nd</sup> 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
20NHOP723A	5G MOB	ILE
	COMMUN	ICATION
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	-

# VIII SEMESTER (SYLLABUS)

# Internet of Things

<b>Course Code</b>	: 20ECE811A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the basic concepts of Internet of Things and API's
CO2	Illustrate the IoT Architectural features and Reference model
CO3	Analyze the difference between IoT and M2M and various network function virtualization
CO4	Identify the IoT protocols and IoT security issues
CO5	Design IoT applications in different domain and analyze their performance
CO6	Develop real time applications using IoT models

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

	SYLLABUS				
Module no	Module Contents	Hrs	COs		
1	Introduction to Internet of things Introduction: Definition and characteristics of IoT, Physical design of IoT: Things in IoT, IoT protocols, Logical Design of IoT: IoT functional blocks, IoT communication models IoT API's, IoT enabling technologies Text 1 : 1.1 – 1.4	9	CO1		
2	<b>IoT Architecture</b> Introduction, Reference Model and architecture, IoT reference Model. IoT Physical device and endpoint: What is an IoT device, Basic building blocks of IoT, Sensors for IoT Applications Text 2: 1.3 Text 1 : 7.1	9	CO2		
3	IoT & M2M Introduction, Machine to Machine, Difference between IoT and	9	CO3		

	M2M, SDN and NFV for IoT: Software define Network and Network Function Virtualization		
	Text 1: 3.1- 3.4		
	IoT Privacy, Security and Vulnerabilities Solutions		
4	Introduction, vulnerabilities and security requirements and threat analysis, Use Cases and misuse cases, IoT Security Tomography and Layered Attacker Model, Message Communication, Security Models, Profiles and Protocols for IoT Text 2: 10.1 – 10.6	9	CO4, CO6
5	<b>Domain specific applications of IoT</b> Home automation, Smart environment, smart cities, logistics, retail, smart energy, smart agriculture, industrial control and smart health. Text $1: 2.1 - 2.9$	9	CO5, CO6

#### **Text Books:**

- 1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
- 2. Rajkamal, "INTERNET OF THINGS, Architecture and Design Principles", 1st edition, McGraw Hill Education (India) Private Limited, 2017.

#### **Reference Books:**

- Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1<sup>st</sup> Edition, Academic Press, 2014.
- Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 - 2024', YoleDevelopment Copyrights, 2014
- 3. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley Series on Wireless Communication and Mobile Computing 2010.

-	PSO1	PSO2			
20ECE811A	Internet of Things				
CO1	-	-			
CO2	-	-			
CO3	3	2			
CO4	-	-			
CO5	3	2			
CO6	3	2			

## **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

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

## SEE- Semester End Examination (50Marks)

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

# VLSI Design Manufacturing

<b>Course Code</b>	: 20ECE812A	Credits	: 3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3Hrs	SEE Marks	: 50

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

CO1	Discuss the various initial steps involved in the VLSI fabrication process.
CO2	Analyze different Oxidation and lithography methods
CO3	Appraise the deposition and ion implantation mechanisms.
CO4	Apply possible metallization choices for VLSI fabrication
CO5	Analyze the fabrication of NMOS, CMOS memory and bipolar devices
CO6	Understand the nuances of assembly and packaging of VLSI devices.

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

SYLLABUS							
Module No	Module Contents	Hrs	COs				
1	Crystal growth, wafer preparation and epitaxy Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing considerations, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Text book 1- 1.1, 1.2, 1.3, 1.4, 1.5, 2.2, 2.3, 2.4, 2.5.	9	CO 1				
2	<b>Oxidation, Lithography and Reactive plasma etching</b> Oxidation growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Polysilicon, Oxidation inducted Defects. Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Reactive Plasma Etching techniques and Equipment. Textbook 1- 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 4.1, 4.2, 4.3, 4.4, 4.5, 5.5	9	CO 2				

3	<b>Diffusion, Ion implementation and Metallization.</b> Models of Diffusion in Solids, Diffusion in polycrystalline silicon, Diffusion in SiO <sub>2</sub> , Diffusion Enhancements and Retardations, Ion Implantation Range theory, Implant equipment, Annealing, Shallow junctions,High energy implantation, Metallization choices, Physical vapor deposition – Patterning. Text book 1 – 7.1, 7.2, 7.8, 7.9, 7.10, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 9.1, 9.3, 9.4, 9.5.	9	CO3 CO4
4	Process simulation and VLSI process integration Ion implantation, Diffusion and oxidation, Epitaxy, Lithography, Etching and Deposition, Fundamental considerations for IC Processing, NMOS IC Technology, CMOS IC Technology, MOS Memory IC technology, Bipolar IC Technology, IC Fabrication. Text book 1 –10.1, 10.2, 10.3, 10.5, 10.6, 11.1, 11.2, 11.3, 11.4, 11.5, 11.6, 11.7.	9	CO5
5	Analytical, Assembly Techniques and Packaging of VLSI Devices Analytical Beams, Beam Specimen interactions, Chemical methods, Package types, Packaging design considerations, VLSI assembly technology, Package fabrication technology. Text book 1 – 12.1, 12.2, 12.3, 12.4, 13.1, 13.2, 13.3, 13.4, 13.5.	9	CO6

#### **Text Books:**

1. S.M.Sze, "VLSI Technology", Mc.Graw.Hill Second Edition. 2015.

#### **Reference Books:**

- 1. S.K. Ghandhi, "VLSI Fabrication Principles", John Wiley Inc., New York, 1994, Second Edition.
- 2. Wayne Wolf," Modern VLSI Design", Prentice Hall India.1998.

## Mapping of CO v/s PSO:

-	PSO1	PSO2				
20ECE812A	VLSI Design Manufacturing					
CO1	-	-				
CO2	3	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	5		
Understand	5	5	
Apply	5	5	5
Analyze	10	5	5
Evaluate			
Create			

# SEE – Semester End Examination (50 Marks)

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

#### **Cellular Mobile Communication**

<b>Course Code</b>	: 20ECE813A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Analyze mobile radio propagation fading, diversity concepts and the channel
	modelling
CO2	Model GSM network architecture and system operation
CO3	Develop a scheme for idle mode, call set up, call progress handling and call tear down
COS	in a CDMA cellular network
CO4	Demonstrate the understanding on basic operations of Air interface in LTE 4G system.
CO5	Compare different multicarrier and multiuser technologies in LTE 4G systems
<u> </u>	Evaluate the design considerations, computational complexity, radio resource
	allocation in cellular systems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO	10	PO	11	PO12				
C01	3	3	3	-	-	-	-	-	-			-		_		_		-
CO2	3	3	3	-	-	-	-	-	-	-		-		2				
CO3	3	3	3	2	-	-	-	-	-	-		-		2				
CO4	3	3	3	-	-	-	-	-	-	-		-		-				
CO5	3	3	3	-	-	-	-	-	-			-		-				
CO6	3	3	3	2	1	-	-	-	-	-		-		2				
					S	YLLA	BUS											
Modu No	le			N	Iodule	Conter	nts			1	Hou	rs	CC	)s				
1		Mobile Radio Propagation – Large Scale Path Loss - Free Space Propagation Model, Relating Power to Electric Field, Three Basic Propagation Mechanisms – Reflection (Ground Reflection), Diffraction, Scattering, Practical Link Budget, (Text 1 - 2.2 and Ref1 - Chapter 4). Fading and Multipath – Broadband wireless channel, Delay Spread and Coherence 9 Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance (Text 1 – 2.4), Statistical Channel Model of a Broadband Fading Channel (Text 1 – 2.5.1) The Cellular Concept – Cellular Concept , Analysis of																
2	2 <b>GSM and TDMA Technology GSM System overview</b> – Introduction, GSM Network and System Architecture, GSM Channel Concept. GSM System Operations – GSM Identities, System Operations –Traffic cases, GSM Infrastructure Communications (Um Interface) (Text 2, Part1 and Part 2 of Chapter 5) <b>CO2</b>						)2											

3	<b>CDMA Technology CDMA System Overview</b> – Introduction, CDMA Network and System Architecture CDMA Basics – CDMA Channel Concepts, CDMA System (Layer 3) operations, 3G CDMA (Text 2-Part 1, Part2 and Part 3 of Chapter 6)	9	CO3
4	LTE – 4G Key Enablers for LTE 4G – OFDM, SC-FDE, SC- FDMA, Channel Dependant Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture. (Text 1, Sec 1.4) Multi-Carrier Modulation – Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ration, SC-Frequency Domain Equalization, Computational Complexity Advantage of OFDM and SC- FDE. (Text 1, Sec $3.1 - 3.7$ )	9	CO4,C06
5	LTE - 4G OFDMA and SC-FDMA – Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity and Opportunistic Scheduling, OFDMA and SC-FDMA in LTE, OFDMA system Design Considerations. (Text 1, Sec 4.1 - 4.6) The LTE Standard – Introduction to LTE and Hierarchical Channel Structure of LTE, Downlink OFDMA Radio Resources, Uplink SC-FDMA Radio Resources. (Text 1, Sec $6.1 - 6.4$ )	9	C05,CO6

#### **TEXT BOOKS:**

- 1. "Fundamentals of LTE" Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed, Pearson education (Formerly Prentice Hall, Communications Engg and Emerging Technologies), ISBN-13: 978-0-13-703311-9.
- 2. "Introduction to Wireless Telecommunications Systems and Networks", Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN 13: 978-81-315-0559-5.

#### **REFERENCE BOOKS**:

- "Wireless Communications: Principles and Practice" Theodore Rappaport, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.
- 2. LTE for UMTS Evolution to LTE-Advanced' HarriHolma and Antti Toskala, Second Edition 2011, John Wiley & Sons, Ltd. Print ISBN: 9780470660003.

-	PSO1	PSO2					
20EC813A	Cellular Mo	Cellular Mobile Communication					
CO1	3	2					
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	-

<b>Course Code</b>	: 20ECE814A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the basic elements of an automated system, its functions and repair			
	diagnostics			
CO2	Compare various industries and study various hardware components			
CO3	Categorize automatic identification methods used for data capturing in industries			
CO4	Analyze various components of manufacturing systems and its types in industrial			
	applications			
CO5	Construct ladder logic diagrams for Programmable devices			
CO6	Interpret robot anatomy, its control system and applications of Industrial Robots			

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

	SYLLABUS		
Modul no	Module Contents	Hrs	COs
1	<b>Introduction:</b> Basic elements of an automated system: Power to accomplish the automated process, Program of Instructions, Control System, Advanced Automation Functions: Safety monitoring, Maintenance and Repair Diagnostics, error detection and recovery, Levels of Automation (Text 1: Sections: 4.1,4,2,4.3)	9	CO1
2	Industrial Control systems and componentsIndustrial Control systems: Process Industries verses discretemanufacturing industries, continuous verses discrete control,Computer process control (Text 1, Sections: 5.1,5,2,5,3)	9	CO2

	Components: Sensors, Actuators, Analog to digital Conversions,		
	Input/output devices for discrete data (Text 1: Sections:		
	6.1,6.2,6.3,6.4)		
	Automatic Identification methods and Manufacturing systems		
	Overview of Automatic Identification method, Bar Code		
	Technology (Linear and Two dimensional), Radio Frequency		
	identification, Magnetic stripes, Optical Character Recognition,		
	Machine vision.		CO3,CO4
3	(Text 1: 12.1,12.2,12.3,12.4)	9	, , , , , , , , , , , , , , , , , , ,
	Components of Manufacturing systems: Production machines,		
	Material Handling system, Types of Manufacturing systems: Types		
	of operations, Number of workstations and layout, Level of		
	automation, system flexibility		
	(Text1: 13.1.1,13.1.1.2,13.2)		
	Discrete control and Programmable Logic Controllers:		
	Discrete Process Control, Ladder logic diagrams, Programmable	_	
4	logic controllers, Personal Computers and programmable	9	CO5
	automation Controllers		003
	(Text 1: Sections: 9.1,9.2,9.3,9.4)		
	Industrial Robotics		
_	Robot anatomy and related attributes, Robot Control Systems,		<b>GQ</b> (
5	End effectors, Applications of Industrial Robots, Robot	9	CO6
	Programming, Robot accuracy and Repeatability.		
	(Text1 : Sections : 8.1,8,2,8.3,8.4,8.5,8.6)		

#### **Text Books:**

1. Automation, Production Systems, and Computer-integrated manufacturing, 4<sup>th</sup> edition, Mikell P.Groover, Pearson publications .

#### **Reference books**:

- 1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
- 2. Process Control Instrumentation Technology By. C.D. Johnson, PHI
- 3. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, Jaico Publishing House, 2013

-	PSO1	PSO2			
20ECE814A	Industrial Automation				
CO1	-	-			
CO2	-	-			
CO3	3	3			
CO4	3	3			
CO5	3	3			
CO6	3	3			

## Assessment Pattern

CIE – Continuous Internal Evaluation (50 Marks)

<b>Bloom's Taxonomy</b>	Tests	Assignments	Quizzes
Marks	25	15	10
Remember	5		
Understand	5		5
Apply	5	5	5
Analyze	10	5	
Evaluate		5	
Create			

# SEE – Semester End Examination (50 Marks)

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

# Python and R Programming

<b>Course Code</b>	: 20ECE815A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Demonstrate the salient features, control flow tools of python
CO2	Develop stacks and queues using the concept of lists
CO3	Compare list with tuple and dictionaries
CO4	Illustrate object-oriented concepts using python programming
CO5	Understand the basic data structures available in R-programming
CO6	Develop interactive applications for a given real world requirements

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

	SYLLABUS					
S.No.	Module Contents	Hrs	COs			
1	Running Python, The first Python program, Arithmetic operators, values and types, variables, expressions and statements: order of operation <b>Control flow tools</b> : IF statement, for, range function, break and continue	9	CO1, CO6			
	statements, else clause in loops, pass statement, While statement. <b>Strings:</b> A string is a sequence, Len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and counting, String methods, The in operator, String comparison <b>Text 1:</b> 1, 1, 5, 2, 1, 2, 5, 8, 1, 8, 10 : <b>Text 2:</b> 4, 1, 4, 5					
2	<b>Defining functions</b> : Default Argument Values, Keyword Arguments, Arbitrary Argument Lists, Lambda Forms, Using Lists as Stacks, Using Lists as Oueues, List Comprehensions	9	CO2, CO6			
	Lists: A list is a sequence, Lists are mutable, traversing a list, List operations, List slices, List methods, Map, filter and reduce, deleting elements, Lists and strings, Objects and values, Aliasing, List arguments <b>Text 1</b> : 10.1 -10.12;					

	<b>Text 2</b> : 4.7.1 - 4.7.4, 5.1.1 - 5.1.4		
3	Dictionaries: A dictionary is a mapping, Dictionary as a collection of	9	CO3, CO6
	counters, Dictionaries and lists, Global variables		
	Tuple: Tuples are immutable, Tuple assignment, Tuples as return values,		
	Variable-length argument tuples, Lists and tuples, Dictionaries and tuples		
	Text1: 11.1, 11.2, 11.5, 11.7		
	<b>Text1</b> : 12.1 – 12.6		
	Files: Reading and writing, Format operator, filenames and paths		CO4,CO6
4	Classes and objects: Programmer-defined types, Attributes, Instances as	9	
	return values, Objects are mutable, Copying		
	Classes and methods: Object-oriented features, Printing objects, The init		
	method, The <u>str</u> method		
	<b>Text 1:</b> 14.2 – 14.4, 15.1 – 15.6, 17.1-17.2, 17.5–17.6		
5	R- Programming: How to run R, R session, Introduction to functions		CO5, CO6
	Preview of R data structures: Vectors, Scalars, Character Strings,	9	
	Matrices, Lists, Data frames, Classes		
	<b>Text 3:</b> 1.1 – 1.4		

#### **Text Books:**

- 1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist '',2nd Edition, Version 2.2.23, Green Tea Press.
- 2. An Introduction to Python, Guido van Rossum and Fred L. Drake Jr, Published by Network Theory Ltd, 2011.
- 3. THE ART OF R PROGRAMMING, Norman Matloff, 2011 edition

#### **Reference Books:**

- 1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press, 2013.
- 2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
- 3. Timothy A. Budd, —Exploring Pythonl, Mc-Graw Hill Education (India) Private Ltd., 2015

-	PSO1	PSO2		
20ECE815A	Python and R Programming			
CO1	3	3		
CO2	3	3		
CO3	3	3		
CO4	3	3		
CO5	-	-		
CO6	3	3		

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

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

# SEE- Semester End Examination (50 Marks)

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

# **Optical Networks**

Course Code : 20ECE816A	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	Understand the structures of Optical fiber and modes of signal propagation
CO2	Apply the transmission characteristics to discuss the channel impairments and dispersion in optical fiber communication
CO3	Categorize the different Optical sources used in optical fiber communication
<b>CO4</b>	Illustrate the constructional features of optical detectors
CO5	Analyze the networking aspects for the design considerations of optical fiber
CO6	Understand the WDM Concepts, standards and its types.

	PO1	PO2	PO3	PO4	PO5	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2
CO4	3	3	2	-	-	-	-	-	-		-	-
CO5	3	3	2	-	1	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-		_	2

SYLLABUS					
Module	Module Contents	Hours	COs		
No					
1	Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers. Text 1 :2.8 Text 2:1.11.3,2.3(2.3.2,2.3.3,2.3.6),2.4,2.5.	9	CO1		

2	Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber. Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber connectors: Cylindrical ferrule connectors, Duplex and Multiple fiber connectors, Fiber couplers: three and four port couplers, star couplers, Optical Isolators and Circulators. Text 1 10.2 & 10.3 Text 2:3.1-3.9 & 4.10.	9	CO2
3	Optical sources: Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies. Text 2-4.2 & 4.3	9	CO3
4	Photo detectors: Physical principles of Photodiodes, Photo detector noise, Detector response time. Optical Receiver: Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit. Text1-6.1-6.3 & 7.1-7.2	9	CO4
5	WDM Concepts and Components: Overview of WDM: Operational Principles of WDM, WDM standards, Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings. Optical amplifiers: Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers. Text 1: 10.1-10.7 &11.1-11.8(Excluding 11.4-11.6)	9	C05,CO6

#### **TEXT BOOKS:**

- Gerd Keiser, Optical Fiber Communication, 5thEdition, McGraw Hill Education(India) Private Limited, 2015. ISBN:1-25-900687-5.
- John M Senior, Optical Fiber Communications, Principles and Practice, 3 rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3

#### **REFERENCE BOOKS**:

1. Joseph C Palais, Fiber Optic Communication, Pearson Education, 2005, ISBN:0130085103.

-	PSO1	PSO2			
20ECE816A	Optical Networks				
CO1	-	-			
CO2	3	2			
CO3	3	2			
CO4	-	-			
CO5	3	2			
CO6	-	-			

#### **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	-

# Switching and Finite Automata Theory

<b>Course Code</b>	: 20ECE821A	Credits	: 3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Make use of mapping tool to synthesize threshold logic
CO2	Analyse effects of hazards and fault diagnosis in digital logical circuits
CO3	Examine the capabilities of Finite State Machines by minimization Procedures
CO4	Model the structures of sequential machines
CO5	Develop the methods of state identification and fault detection
CO6	Design the fault detection algorithm

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	2	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	3	3	-	1	-	-	-	-	-	-	1
CO6	3	3	3	-	1	-	-	-	-	-	-	1

SYLLABUS				
Module	Module Contents	Hours	COs	
No				
1	Threshold Logic: Introductory Concepts: Threshold element, capabilities and limitations of threshold logic, Elementary Properties, Synthesis of Threshold networks: Unate functions, Identification and realization of threshold functions, The map as a tool in synthesizing threshold networks. Text1: Sections 7.1, 7.2	9	C01	
2	Reliable Design and Fault Diagnosis: Hazards, static hazards, Design of Hazard-free Switching Circuits, Fault detection in combinational circuits, Fault detection in combinational circuits: The faults, The Fault Table, Covering the fault table, Fault location experiments: Preset experiments, Adaptive experiments, Boolean differences, Fault detection by path sensitizing. Text1: Sections 8.1, 8.2, 8.3, 8.4, 8.5	9	CO2	

3	Sequential Machines: Capabilities, Minimization and Transformation the Finite state model and definitions, capabilities and limitations of finite state machines, State equivalence and machine minimization: k-equivalence, The minimization Procedure, Machine equivalence, Simplification of incompletely specified machines. Text1: Section 10.1, 10.2, 10.3, 10.4	9	CO3
4	Structure of Sequential Machines: Introductory example, State assignment using partitions: closed partitions, The lattice of closed partitions, Reduction of output dependency, Input dependence and autonomous clocks, Covers and generation of closed partitions by state splitting: Covers, The implication graph, An application of state splitting to parallel decomposition. Text1: (Section 12.1, 12.2, 12.3, 12.4, 12.5, 12.6	9	CO4
5	State–Identification and Fault Detection Experiments: Experiments, Homing experiments, Distinguishing experiments, Machine identification, Fault detection experiments, Design of diagnosable machines, Second algorithm for the design of fault detection experiments. Text1: Sections 13.1, 13.2, 13.3, 13.4, 13.5, 13.6, 13.7	9	C05,CO6

#### **TEXT BOOKS:**

1. Switching and Finite Automata Theory – ZviKohavi, McGraw Hill, 2nd edition, 2010 ISBN: 0070993874.

#### **REFERENCE BOOKS**:

- 1. Fault Tolerant And Fault Testable Hardware Design-Parag K Lala, Prentice Hall Inc. 1985.
- 2. Digital Circuits and Logic Design.-Charles Roth Jr, Larry L. Kinney, Cengage Learning, 2014, ISBN: 978-1-133-62847-7.

#### Mapping of CO v/s PSO:

-	PSO1	PSO2
20ECE821A	Switching	and Finite Automata Theory
CO1	-	-
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

## **Assessment Pattern**

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

# CIE- Continuous Internal Evaluation (50 Marks)

# SEE- Semester End Examination (50 Marks)

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

# **Digital Neurocomputing**

<b>Course Code</b>	: 20ECE822A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
<b>Exam Hours</b>	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the basics of Neuro Science and brain theory
CO2	Examine the fundamentals of Neural Networks and Genetic Algorithms
CO3	Analyze various aspects of learning techniques in Machine Learning.
CO4	Apply neural networks and genetic algorithms effectively for appropriate applications
CO5	Analyze Instance based learning techniques and learning rule sets.
CO6	Differentiate reinforcement and analytical learning techniques by inspecting various
	approaches and choose the right method for related applications

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	1	-	-	-	-	-	-	2
CO4	3	3	3	-	1	-	-	-	-	-	-	2
C05	3	3	3	-	-	-	-	-	-	-	-	-
CO6	3	3	3	2	-	-	-	-	-	-	-	2

SYLLABUS						
Module	Module Contents	Hours	COs			
No						
1	<b>Introduction:</b> Computational Neuroscience, Tools and specializations in neuroscience, Brain theory, basic synaptic mechanism and dendritic processing, simplified neuron and population models, spiking neurons, population dynamics, Network with non-classical synapses Text-1: 1.1, 1.3, 2.1, 2.2, 2.3 (up to 2.3.4), 3.1,3.2,3.4,3.5	9	CO1			
2	Neural Networks and Genetic Algorithms: Neural Network Representation, Problems, Perceptrons, Multilayer Networks and Back Propagation Algorithms, Advanced Topics, Genetic Algorithms, Hypothesis Space Search, Genetic Programming, Models of Evolution and Learning. Text-2: 4.2,4.3,4.4,4.5,4.6,9.2,9.4,9.5,9.6	9	CO2			

3	<b>Bayesian and Computational Learning:</b> Bayes Theorem, Concept Learning, Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Gibbs Algorithm, Naïve Bayes Classifier, Bayesian Belief Network, EM Algorithm, Probably Learning, Sample Complexity for Finite and Infinite Hypothesis Spaces, Mistake Bound Model. Text-2: 6.2, 6.3, 6.6, 6.7, 6. 8, 6.9, 6.11, 6.12, 7.2, 7.3, 7.4, 7.5	9	CO3, CO4
4	<b>Instance- Based Learning and Learning Sets of Rules:</b> K- Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Sequential Covering Algorithms, Learning Rule Sets, Learning First Order Rules, Learning Sets of First Order Rules, Induction as Inverted Deduction, Inverting Resolution. Text-2: 8.2, 8.3, 8.4, 8.5, 10.2, 10.3, 10.4, 10.5, 10.6, 10.7	9	CO4, CO5
5	Analytical Learning and Reinforced Learning: Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches - FOCL Algorithm, Reinforcement Learning, Task, Q-Learning, Temporal Difference Learning Text-2: 11.2,11.3,11.4,12.2, 12.5.1, 13.3, 13.5	9	CO6

#### **TEXT BOOKS:**

- 1. "Fundamental of Computational Neuroscience", Thomas Trappenber, OUP Oxford, 2010
- 2. "Machine Learning" Tom M. Mitchell, McGraw-Hill Education, 2013.

#### **REFERENCE BOOKS**:

- "Introduction to Machine Learning", Ethem Alpaydin PHI Learning Pvt. Ltd 2nd Ed., 2013
- 2. "The Elements of Statistical Learning", T. Hastie, R. Tibshirani, J. H. Friedman Springer, 1st edition, 2001

#### Mapping of CO v/s PSO:

-	PSO1	PSO2
20ECE822A	Digital	Neurocomputing
CO1	-	-
CO2	3	3
CO3	3	3
CO4	3	3
CO5	3	3
CO6	3	3

## **Assessment Pattern**

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

# CIE- Continuous Internal Evaluation (50 Marks)

## SEE- Semester End Examination (50 Marks)

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

# Pattern Recognition & Application

<b>Course Code</b>	: 20ECE823A	Credits	: 3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
Exam Hours	: 3 Hrs	SEE Marks	: 50

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

CO1	Understand the basic concepts in pattern Recognition and compute features useful for
COI	image representation
CO2	Differentiate procedures, methods and algorithms related to pattern recognition
CO3	Analyze pattern recognition theories, such as Bayes classifier, linear discriminant
005	analysis
<b>CO4</b>	Compare the different pattern classification
CO5	Analyze state-of-the-art algorithms used in pattern recognition
CO6	Make use of pattern recognition techniques for solving complex problems.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-		-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
<b>CO4</b>	3	3	2	-	-	-	-	-	-	-	-	2
C05	3	3	2	-	-	-	-	-	-	-	-	2
<b>CO6</b>	3	3	3	2	-	-	-	-	-	-	-	2

SYLLABUS					
Module	Module Contents	Hours	COs		
No					
1	<b>Introduction:</b> Feature extraction and Pattern Representation Concept of Supervised and Unsupervised classification Introduction to Application Areas.	9	C01		
2	<b>Statistical Pattern Recognition</b> Bayes Decision Theory, Minimum Error and Minimum Risk Classifiers, Discriminant Function and Decision Boundary Normal Density, Discriminant Function for Discrete Features, Parameter estimation	9	CO2,CO3		

3	<b>Dimensionality Problem</b> Dimension and accuracy, Computational Complexity, Dimensionality Reduction, Fisher Linear Discriminant, Multiple Discriminant Analysis <b>Nonparametric Pattern Classification</b> Density Estimation, Nearest Neighbour Rule, Fuzzy Classification	9	CO3,CO4
4	Linear Discriminant Functions Separability, Two Category and Multi Category Classification, Linear Discriminators, Perceptron Criterion, Relaxation Procedure, Minimum Square Error Criterion, Widrow-Hoff Procedure, Ho-Kashyap Procedure, Kesler's Construction. Neural Network Classifier Single and Multilayer Perceptron, Back Propagation Learning, Hopfield Network, Fuzzy Neural Network.	9	CO3,CO4
5	<b>Time Varying Pattern Recognition</b> First Order Hidden Markov Model, Evaluation, Decoding, Learning <b>Unsupervised Classification</b> Clustering, Hierarchical Clustering, Graph Based Method, Sum of Squared Error Technique	9	CO4, CO5, CO6

#### **TEXT BOOKS:**

- 1. Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", John Wiley & Sons, 2001.
- **2.** Earl Gose, Richard Johsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall, 1999.

#### **REFERENCES:**

- 1. M. Narasimha Murthy and V. Susheela Devi, "Pattern Recognition", Springer 2011.
- 2. Andrew Webb, "Stastical Pattern Recognition", Arnold publishers, London, 1999
- 3. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Ed., Academic Press. 2009
- 4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer publisher, 2006

-	PSO1	PSO2
20ECE823A	Pattern R App	Recognition & Dication
CO1	-	-
CO2	3	2
CO3	3	2
CO4	-	-
CO5	3	3
CO6	3	2

#### **Assessment Pattern**

CIE- Continuous Internal Evaluation (50 Marks)

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

## SEE- Semester End Examination (50 Marks)

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

Course Code : 20ECE824A L:T:P:S : 3:0:0:0 Exam Hours : 3 Hrs Credits: 3CIE Marks: 50SEE Marks: 50

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

CO1	Understand the fundamental concepts of radar
CO2	Select the radar system for the prediction of moving targets
CO3	Inspect the tracking principles of RADAR
CO4	Infer the noise signals in automatic detection of radar
CO5	Apply the information from Radar signals for real time applications
CO6	Analyze Radar range measurement for different radar applications

	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2
CO3	3	3	3	2	-	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	1	-	-	-	-	-
CO5	3	3	3	2	1	-	-	-	-	-	-	2
CO6	3	3	3	2	-	-	-	-	-	-	-	-

SYLLABUS						
Module No	Module Contents	Hours	COs			
1	<b>Introduction to Radar:</b> Basic Radar, The Simply Form of the Radar Equations, Radar Block Diagram, Radar Frequencies, Applications of Radar. The Radar Equation: Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar Cross Section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses, Problems. Antenna Patterns <b>Text1:</b> 1.1, 1.2, 1.3, 1.4, 1.5, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12 <b>Text 2</b> : Chapter 1 & 2 – 2.2	9	CO1			
2	MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line Cancelers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks,	9	CO2			
	Digital MTI Processing, Moving Target Detector, Limitations to					
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	Text 1:31, 32, 33, 34, 35, 36, 37, 38.					
	Tracking Radar:					
	Tracking with Radar, Mono pulse Tracking, Conical Scan and					
2	Sequential Lobing, Limitations to tracking Accuracy, Low Angle	0	CO2			
3	Tracking, Tracking in Range, Other Tracking Radar Topics,	9				
	Comparison of Trackers, Automatic Tracking with Surveillance					
	Radars (ADT)					
	<b>Text 1:</b> 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9					
	Detection of Signals in Noise:					
4	Introduction, Detection Criteria, Detectors, Automatic Detection,	9	CO4			
	Integrators, Constant-False-Alarm Rate Receivers.					
	<b>Text 1</b> :5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7					
	Information from Radar Signals:					
	Basic Radar Measurements, Theoretical Accuracy of Radar					
	Measurements, Ambiguity Diagram, Pulse Compression, Target					
5	Recognition, Land Clutter, Sea Clutter, Weather Clutter	9	CO5			
5	Waveform and Signal Processing –Range Measurements, Angle	-	000			
	Measurements, Doppler Measurements					
	<b>Text 1:</b> 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 7.3, 7.4, 7.6					
	<b>Text 2 :</b> Chapter 5 5.1,5.2,5.3,5.4,5.5					

### **Text Books:**

1. Merrill I. Skolnik "Introduction to Radar Systems" Third Edition,2001, McGraw Hill Higher Education.

#### **Reference Books:**

1. J.C. Toomay, Paul J. Hannen "Principles of Radar" Third Edition, PHI 2010

### Mapping of CO v/s PSO:

-	PSO1	PSO2
20ECE824A	Radar	Networks
CO1	-	-
CO2	3	3
CO3	3	3
CO4	-	-
CO5	3	3
CO6	3	3

### **Assessment Pattern**

# CIE- Continuous Internal Evaluation (50 Marks)

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

# SEE- Semester End Examination (50 Marks)

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

# Wireless and High-Speed Integrated Circuits and Systems

<b>Course Code</b>	: 20ECE825A	Credits	:3
L:T:P:S	: 3:0:0:0	<b>CIE Marks</b>	: 50
<b>Exam Hours</b>	: 3 Hrs	SEE Marks	: 50

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

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sing
5

### Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2
CO3	3	3	3	-	-	-	-	-	-	-	-	2
CO4	3	3	-	-	-	-	-	-	-	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-
CO6	3	3	3	2	1	1	1	-	-	-	-	2

Module	Module Contents	Hours	COs
No	Introduction to RF Design, Wireless Technology and Basic		
1	<b>Concepts:</b> A wireless world, RF design is challenging, The big picture. General considerations, Analog and Digital Technology, Effects of Nonlinearity, Noise, Sensitivity and dynamic range, Passive impedance transformation. <b>Text-1:Chapter 1:1.1-1.3, Chapter2: 2.1-2.5.</b>	9	CO1
2	<b>Communication Concepts:</b> General concepts, analog modulation, digital modulation, spectral re-growth, coherent and non-coherent detection, Mobile RF communications, Multiple access techniques, Wireless standards, Appendix 1: Differential phase shift keying. Text-1: Chapter 3: 3.1- 3.8.	9	CO2
3	<b>High Speed VLSI Design:</b> Interconnections for VLSI Applications, Copper Interconnections, Method of Images, Method of Moments, Even- and Odd-Mode Capacitances, Transmission Line Equations, Miller's Theorem, Inverse Laplace Transformation, Resistive Interconnection as Ladder Network, Propagation Modes in Micro strip Interconnection, Slow-Wave Mode Propagation, Propagation Delays. <b>Text-2:1.1-1.12.</b>	9	CO3,CO4
4	<b>Interconnection Delays</b> : Metal–Insulator–Semiconductor Microstrip line Model of an Interconnection, Transmission Line Analysis of Single-Level Interconnections, Transmission Line Analysis of Parallel Multilevel Interconnections, Analysis of Crossing Interconnections, Parallel Interconnections Modelled as Multiple Coupled Microstrips.Very High Frequency Losses in Microstrip Interconnection, Compact Expressions for Interconnection Delays, Interconnection Delays in Multilayer Integrated Circuits. <b>Text-2:3.1</b> - <b>3.5, 3.7- 3.9</b>	9	CO4, CO5
5	Crosstalk Analysis: Lumped-Capacitance Approximation, Coupled Multiconductor MIS Microstrip line Model of Single-Level Interconnections, Frequency-Domain Modal Analysis of Single-Level Interconnections. Transmission Line Analysis of Parallel Multilevel Interconnections, Analysis of Crossing Interconnections, Compact Expressions for Crosstalk Analysis, Multiconductor Buses in GaAs High-Speed Logic Circuits. <b>Text-2: 4.1-4.7</b>	9	CO5,CO6

## **TEXT BOOKS:**

- 1. "RF Microelectronics", B. Razavi, PHI second edition, 1998.
- 2. "High-Speed VLSI Interconnections", Ashok K. Goel, Wiley, 2007.

#### **REFERENCE BOOKS**:

- "CMOS Circuit Design, layout and Simulation", R. Jacob Baker, H.W. Li, D.E. Boyce, PHI 1998
- 2. "Design of CMOS RF Integrated Circuits", Thomas H. Lee, Cambridge University press 1998
- 3. "Mixed Analog and Digital Devices and Technology", Y.P. Tsividis TMH 1996

### Mapping of CO v/s PSO:

-	PSO1	PSO2			
20ECE825A	Wireless and High-Speed Integrated Circuits and Systems				
CO1	3	2			
CO2	3	2			
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	-

Course Code	: 20ECE826A	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	Understand the basic concepts of blockchain
CO2	Apply the basic distributed computing and crypto primitives in blockchain
CO3	Inspect the technological challenges faced by BITCOIN 1 and real-world consensus
CO4	Distinguish between BITCOIN 1 and 2 based on functionalities
CO5	Describe the mechanisms in smart contracts and Ethereum blockchain
CO6	Summarize the benefits of blockchain outside of currencies.

# Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-
C05	3	-	-	-	-	-	-	-	-	-	-	-
CO6	3	3	-	-	-	-	-	-	-	-	-	-

SYLLABUS							
Module No	Module Contents	Hours	COs				
1	<b>Blockchain 101:</b> Distributed systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain. Text 1 : Chapter 1	9	CO1				
2	<b>Decentralization and Cryptography:</b> Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Decentralized organizations. Cryptography and Technical Foundations: Cryptographic primitives, Asymmetric cryptography, Public and private keys Text 1 : Chapter 2, Chapter 3	9	CO2				

3	<ul> <li>Bitcoin and Alternative Coins</li> <li>A: Bitcoin, Transactions, Blockchain, Bitcoin payments</li> <li>B: Alternative Coins: Theoretical foundations, Bitcoin limitations, Namecoin, Litecoin, Primecoin, Zcash</li> <li>Text 1 : Chapter 4, Chapter 5</li> </ul>	9	CO3, CO4
4	Smart Contracts and Ethereum 101: Smart Contracts: Definition, Ricardian contracts. Ethereum 101: Introduction, Ethereum blockchain, Elements of the Ethereum blockchain, Precompiled contracts. Text 1 : Chapter 6, Chapter 7	9	CO5
5	Alternative Blockchains: Blockchains Blockchain-Outside of Currencies: Internet of Things, Government, Health, Finance, Media Text 1 : Chapter 10, Chapter 11	9	CO6

#### Textbook

 Mastering Blockchain - Distributed ledgers, decentralization and smart contracts explained, Author- Imran Bashir, Packt Publishing Ltd, Second Edition, ISBN 978-1-78712-544-5, 2017

#### **Reference Books**

- 1. Bitcoin and Cryptocurrency Technologies, Author- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University, 2016
- 2. Blockchain Basics: A Non-Technical Introduction in 25 Steps, Author- Daniel Drescher, Apress, First Edition, 2017
- 3. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media, First Edition, 2014

-	PSO1	PSO2			
20ECE826A	Block (	Chain Technology			
CO1	-	-			
CO2	3	2			
CO3	3	2			
CO4	3	2			
CO5	-	_			
CO6	-	-			

### Mapping of CO v/s PSO:

#### **Assessment Pattern**

# CIE- Continuous Internal Evaluation (50 Marks)

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

# SEE- Semester End Examination (50 Marks)

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

INTERNSHIP					
<b>Course Code</b>	20ECL83A	Credits	04		
L: T: P: S	0:0:0:0	CIE Marks	50		
<b>Exam Hours</b>	03	SEE Marks	50		

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

CO1	Understand industry/Organization customs and practices
CO2	Demonstrate professional and technical skills that pertain directly to the internship experience
CO3	Demonstrate effective listening skills verbal and written communication skills
CO4	Demonstrate appropriate workplace attitudes and individual responsibility
CO5	Participate well as a team member, Allocate time effectively and build professional network
CO6	Demonstrate effective management of personal behavior, ethics and attitudes and practice ethical standards appropriate to the internship site

## Mapping of Course Outcomes to Program Outcomes:

СО	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C01	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	-	-	3	3	3				3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	-		3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-		3	-	3	3	-	-
CO6	-	-	-	-	-	-		3	3	-	3	-	-	-

### **CIE - Continuous Internal Evaluation (50)**

<b>Bloom's Taxonomy</b>	Internship
Marks (Out of 50)	-
Remember	-
Understand	20
Apply	20
Analyze	10
Evaluate	-
Create	-

### **SEE – Semester End Examination (50)**

<b>Bloom's Taxonomy</b>	Internship
Remember	-
Understand	-
Apply	20
Analyze	20
Evaluate	10
Create	-

Project Phase- 2				
<b>Course Code</b>	20ECL84A	Credits	10	
L: T: P: S	0:0:10:0	CIE Marks	150	
<b>Exam Hours</b>	03	SEE Marks	150	

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

CO1	Engage in independent study to undertake problem identification, formulation and selection of appropriate method for providing solution
CO2	Apply the identified concept and engineering tools to arrive at design solutions for identified problem
CO3	Analyze and interpret results of experiments conducted on the design solution to draw valid conclusions
CO4	Investigate the impact of engineering solutions and also demonstrate concern for environment in a global and social context.
CO5	Ability to perform the budget analysis of the project through the utilization of resources
CO6	Ability to perform in the team, contribute to the team and mentor/lead the team thus enhance professional etiquette and ethics
<b>CO</b> 7	Ability to engage in effective oral and written communication through the project presentation and report
CO8	Ability to abide by the norms of professional ethics

### Mapping of Course Outcomes to Program Outcomes:

СО	PO1	PO2	PO3	PO4	PO5	PO6	<b>PO7</b>	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	-	3	-	-	-	-	-	-	-	3	3
CO3	-	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	-	-	-	-	-	3	3	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-
<b>CO7</b>	-	-	_	-	-	-	-	-	-	3	-	-	-	-
<b>CO8</b>	-	-	-	-	-	-	-	3	-	-	-	-	-	-

### CIE - Continuous Internal Evaluation (150)

<b>Bloom's Taxonomy</b>	Project Phase - 2
Marks (Out of 150)	-
Remember	-
Understand	-
Apply	50
Analyze	50
Evaluate	25
Create	25

## SEE – Semester End Examination (150)

<b>Bloom's Taxonomy</b>	Project Phase - 2
Remember	-
Understand	-
Apply	50
Analyze	50
Evaluate	25
Create	25

# 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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