NEW HORIZON COLLEGE OF ENGINEERING

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

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

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

Awarded Outstanding Technical Education Institute in Karnataka

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

Academic Year 2018-19

ECE - Electronics & Communication Engineering

Seventh and Eighth Semesters
Scheme and Syllabus

VISION

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

MISSION

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

Program Education objectives (PEOs)

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

PEO to Mission Statement Mapping

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

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

Program Outcomes (PO) with Graduate Attributes

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

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

Program Specific Outcomes

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

Mapping of PEOs to POs & PSOs

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

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

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2015 -2019

Department of Electronics and Communication Engineering

Scheme of Seventh and Eighth Semester

Fourth Year / Seventh Semester													
Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE71	Wireless and Mobile Communications	3	2	0	0	5	3	4	75	75	150
2	ECE72	Antennas and Wave Propagation	3	0	0	0	3	4	0	50	50	100
3	ECE73X	Professional Elective – III	3	0	0	1	4	3	0	50	50	100
4	ECE74X	Professional Elective – IV	3	0	0	1	4	3	0	50	50	100
5	ECE75X	Professional Elective – V	3	0	0	1	4	3	0	50	50	100
6	NHOPXX	Open Elective – II	3	0	0	1	4	3	0	50	50	100
TOTAL							**24**	**19**	**4**	**325**	**325**	**650**

Fourth Year / Eighth Semester													
Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE81	Routing and switching-03	3	0	0	1	4	3	0	50	50	100
2	ECE82	Internship	0	4	0	0	4	0	0	50	50	100
2	ECE83	Project Phase – I	0	1	0	0	1	0	4	25	25	50
3	ECE84	Project Phase – II	0	1	0	0	1	0	4	25	25	50
4	ECE85	Project Phase – III	0	10	0	0	10	0	12	100	100	200
TOTAL							**20**	**3**	**20**	**250**	**250**	**500**

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2015 -2019

Department of Electronics and Communication Engineering

Academic Year: 2018 – 2019

Syllabus of Seventh Semester

Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE71	Wireless and Mobile Communications	3	2	0	0	5	3	4	75	75	150
2	ECE72	Antennas and Wave Propagation	3	0	0	0	3	4	0	50	50	100
3	ECE73X	Professional Elective – III	3	0	0	1	4	3	0	50	50	100
4	ECE74X	Professional Elective – IV	3	0	0	1	4	3	0	50	50	100
5	ECE75X	Professional Elective – V	3	0	0	1	4	3	0	50	50	100
6	NHOPXX	Open Elective – II	3	0	0	1	4	3	0	50	50	100
		TOTAL					**24**	**19**	**4**	**325**	**325**	**650**

Professional Elective – III (GROUP 3)
ECE731: Embedded Linux
ECE732: Advanced Semiconductors
ECE733: Satellite Communications
ECE734: Biomedical Signal and Image Processing
ECE735: Artificial Intelligence and Cognitive Computing
ECE736: Software Defined Radio

Professional Elective – IV (GROUP 4)
ECE741: Robotics
ECE742: Low power VLSI Design
ECE743: Wireless Ad-hoc Sensor Networks
ECE744: Multimedia Signal Processing and Coding
ECE745: Neural Networks
ECE746: Renewable Energy

Professional Elective – V (GROUP 5)
ECE751: Internet of Things
ECE752: VLSI Design Manufacturing
ECE753: Network Security and Cryptography
ECE754: Industrial Automation
ECE755: Routing and Switching – 2
ECE756: Automotive Electronics

Open Elective – II
NHOP01: Big Data Analytics using HP Vertica - 1
NHOP02: VM Ware virtualization Essentials - 1
NHOP03: Adobe Experience manager - 1
NHOP04: Big Data Analytics using HP Vertica - 2
NHOP05: VM Ware virtualization Essentials – 2
NHOP06: Adobe Experience manager - 2
NHOP07: SAP
NHOP08: Schneider - Industry Automation
NHOP09: Cisco - Routing & Switching – 1
NHOP10: Data Analytics
NHOP11: Machine Learning
NHOP12: Cisco - Routing & Switching – 2
NHOP13: Industrial IoT - Embedded Systems
NHOP14: Blockchain
NHOP15: Product Life Cycle Management
NHOP16: Cisco - Routing & Switching - 3

WIRELESS AND MOBILE COMMUNICATIONS			
Course Code	**:ECE71**	**Credits**	**:05**
L: P: T: S	**:3:2:0:0**	**CIE Marks**	**:50+25**
Exam Hours	**:03+03**	**SEE Marks**	**:50+25**

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

CO1	Utilize the basics of wireless communication to deal the technical challenges in cellular system design
CO2	Examine the appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium
CO3	Determine the appropriate wireless technology to build smart society applications
CO4	Appraise the concept of smart multi antenna systems for advanced wireless communication
CO5	Examine the concepts of wireless communication using Simulation tools
CO6	Analyze the transmitter and receiver diversity techniques to support real-time applications over wireless networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	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.	9	CO1 CO3 CO5
	LIST OF EXPERIMENTS: 1. Study of basic operation of a spectrum analyzer	6	
2	**Free Space Propagation Model** 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) Out door and Indoor Propagation models–Okumura model, Hata model, log 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.	9	CO1 CO2 CO5

	LIST OF EXPERIMENTS: 1. Simulation of Okumura model using MATLAB 2. Simulation of Hata model using MATLAB 3. Simulation of log normal shadowing model using MATLAB	6	
3	**Wireless standards** Introduction to wireless standards – 1G-AMPS, 2G. GSM services and features, System architecture, Radio subsystem, channel types, Frame structure for GSM CDMA (IS-95) – CDMA frequency bands, Forward and Reverse CDMA Channel.	9	CO3 CO5
	LIST OF EXPERIMENTS: 1. Study of DS-SS modulation/Demodulation Process(trainer kit based) 2. Study of CDMA(DS-SS)technique using analog signal as an input signal(trainer kitbased) 3. Study and identify different blocks of mobile phone units and 4. Sketch the waveforms of different sections in Mobile Communication Trainer board. 5. To study and execute different types of AT commands using Mobile Communication Trainer board. 6. To realize Voice communication using AT commands(trainer kit based)	6	
4	**OFDM for Wireless Communication** Basic principles of orthogonality, single Vs Multi-carrier systems, OFDM Block diagram, OFDM signal mathematical representation, pilot insertion and channel estimation	9	CO3 CO4 CO5 CO6
	LIST OF EXPERIMENTS: 1. Simulation of OFDM transmitter and receiver using MATLAB.	6	
5	**Multipath Mitigation Techniques** Diversity – Types of Diversity – Diversity combining techniques: Selection, Feedback, Maximal Ratio Combining and Equal Gain Combining Introduction to MIMO, MIMO based system architecture, MIMO channel modeling, Advantages and applications of MIMO	9	CO1 CO4 CO5 CO6
	LIST OF EXPERIMENTS: 1. Simulation of MIMO system using MATLAB	6	

Text Books:

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

2. Wireless Communication, Upen Dalal, 2009, Oxford Univ. Press.

Reference Books:

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

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

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

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

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

Practical (25 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

Practical (25 Marks)

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

ANTENNAS AND WAVE PROPAGATION			
Course Code	**:ECE72**	**Credits**	**:03**
L: P: T: S	**:3:0:0:0**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Analyze antenna parameters and radiation patterns
CO2	Interpret the radiation pattern of antenna arrays for complex engineering problems
CO3	Analyze the performance of antenna using radiation integrals and auxiliary potential
CO4	Evaluate the performance of linear wire antennas for the given specifications
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

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**FUNDAMENTELS OF ANTENNA:** Introduction, Radiation patterns, Radiation Power Density and intensity, Beam-width, Directivity, Antenna Efficiency, Gain, Beam Efficiency, Bandwidth, Polarization, Input Impedance, Antenna Radiation Efficiency, Vector Effective Length and Equivalent Areas, Maximum Effective Area, Antenna temperature, Friis Equation. Antenna field zones	9	CO1 CO2
2	**RADIATIONINTEGRALSANDAUXILIARYPOTENTIAL:** Introduction, The Vector Potential for an Electric Current Source and Magnetic Current Source**,** Fields for Electric and Magnetic Current Sources. Solution of Wave Equation. Far-Field Radiation, Duality, Reciprocity and Reaction Theorems	9	CO3
3	**LINEAR WIRE ANTENNAS:** Introduction, Infinitesimal Dipole, Small Dipole, Region Separation, Finite Length Dipole, Half-Wavelength Dipole, Linear Elements Near or on Infinite Perfect Conductors, Ground Effects.	9	CO4

4	**ANTENNA ARRAYS: LINEAR, PLANAR, AND CIRCULAR:** Introduction, Two-Element Array, N-Element Linear Array: Uniform Amplitude and Spacing, Directivity, N-Element Linear Array: N-Element Uniform Spacing, Non-uniform Amplitude, Planar Array, Circular Array.	9	CO1 CO2 CO5
5	**WAVES PROPAGATION:** Introduction, Ground wave propagation, free space propagation, ground reflection, surface wave, diffraction. Troposcopic scatter, Ionosphere propagation, electrical properties of the ionosphere, effects of earth's magnetic field.	9	CO6

Text Books:

1. Antenna Theory, Analysis, and, Deign, C. A. Balanis, 4th Edition, 2016, John Wiley India Pvt. Ltd.
2. Antennas and Wave Propagation, Harish and Sachidananda, 2007, Oxford Univ. Press.

Reference Books:

1. Antennas and Wave Propagation, John D. Krauss, 5th edition, 2017, McGraw-Hill.
2. Antennas and Propagation for Wireless Communication Systems, S. R. Saunders, 2003, John Wiley.
3. Antennas and Wave Propagation, G. S. N. Raju, 2005, Pearson Education

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

EMBEDDED LINUX			
Course Code	**:ECE731**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Utilize the basic commands of Linux system
CO2	Appraise the programming concepts of Linux Shell
CO3	Select distributions and architectures of Embedded Linux System
CO4	Test the assigned task with GNU Cross Platform Development Tool chain
CO5	Choose and configure Kernel for Embedded Applications
CO6	Build Real Life Embedded Linux systems

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**FUNDAMENTALS OF LINUX** BasicLinuxSystemConcepts:WorkingwithFilesandDirectories–StandardLinux directories,othercommondirectoriesonLinuxsystems.IntroductiontoLinuxFile system–Discs,partitionsandmountpoints,localfilesystem,Networkfilesystem-Working with Partitions and File systems - Understanding Linux Permissions;	**9**	CO1 CO6
2	**FUNDAMENTALS OF LINUX SHELL** Command Line Tools: Executing Commands from the Command Line – IntroductiontoShell-AvailableshellsforLinuxsystems-GettingtoaShell–Popular Command-Line Commands - Working with the Bash Shell	**9**	CO2 CO6
3	**VARIOUS DISTRIBUTIONS AND CROSS PLATFORM TOOL CHAIN** Introduction-HistoryofEmbeddedLinux-EmbeddedLinuxversusDesktopLinux - Commercial Embedded Linux Distribution-Choosing a distribution–Embedded Linux Distributions - Architecture of Embedded Linux – Linux Kernel Architecture Porting Roadmap - GNU Cross Platform Tool chain	**9**	CO3 CO6

4	**HOST-TARGET SETUP AND OVERALL ARCHITECTURE** Real Life Embedded Linux Systems - Design and Implementation Methodology – Types of Host/Target Development Setups –Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup – Types of Boot Configurations - System Memory Layout	**9**	CO4 CO6
5	**KERNEL CONFIGURATION** A Practical Project Workspace - GNU Cross-Platform Development Too chain - C Library Alternatives - Other Programming Languages - Eclipse: An Integrated DevelopmentEnvironment-TerminalEmulators-SelectingaKernel-Configuring the Kernel - Compiling the Kernel - Installing the Kernel.	**9**	CO5 CO6

Text Books:

1. Ubuntu Linux Bible, William Von Hagen, 3rd edition, 2010, Wiley Publishing Inc.
2. Building Embedded Linux Systems, Karim Yaghmour, Jon Masters, Gilad Ben-Yossef and Philippe Gerum, 2nd edition, 2009, SPD-O'Reilly Publications.

Reference Books:

1. Embedded Linux System Design & Development, P. Raghavan, Amol Lad, Sriram Neelakandan, 2012, Auerbach Publications (Taylor and Francis Group).
2. Linux System Programming, Robert Love, 2013, SPD-O'Reilly Publications

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination **Theory (50 Marks)**

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

ADVANCED SEMICONDUCTORS			
Course Code	**:ECE732**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Make use of the principles and fundamentals of semiconductor to understand the crystal structures of semiconductor devices
CO2	Analyze the principles of atomic structure using Quantum mechanics
CO3	Estimate the energy levels of semiconductors and analyze device structures in 1-D as well as in 3-D
CO4	Evaluate the carrier concentration distribution in intrinsic and extrinsic semiconductors
CO5	Model the formulation of the continuity equation based on carrier movements in semiconductors
CO6	Solve density state of semiconductor devices

Mapping of Course Outcomes to Program Outcomes:

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

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

4	**Equilibrium Carrier Statistics**: 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. Extrinsic/Intrinsic. Problems.	9	CO4
5	**Carrier Transport**: Drift. Diffusion. Diffusion. Definition-Visualization. Diffusion Current. Einstein Relationship. Equations of State. Current Equations. Carrier Currents. Dielectric Displacement Current. Quasi Fermi Levels. Continuity Equations. Minority Carrier Diffusion Equations. Problems.	9	CO5 CO6

Text Books:

1. Advanced Semiconductors Fundamentals, Robert F. Pierret, Volume VI - Modular Series on Solid state devices, 2nd edition, 2002, Purdue University**.**

Reference Books:

1. Solid State Electronic Devices, Ben G. Streetman and Sanjay Kumar Banerjee, 7th edition, 2016, Pearson publication.
2. Semiconductor Physics and Devices, Donald Neamen and Dhrubhas Biswas, 2017, Tata Mc Graw Hill Publication.
3. Physics of Semiconductor Devices, S. M. Sze, Kwok K. Ng, 3rd Edition, 2008, Wiley Publication. Publications.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

SATELLITE COMMUNICATION			
Course Code	**:ECE733**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Explain the fundamentals of satellite communication
CO2	Apply transmission loss factors in satellite communication for categorized noises/perturbations
CO3	Apply Kepler laws and understanding various satellite orbits
CO4	Examine process involved in communication between transmitters and receivers with respect to satellite communication
CO5	Identify the working of earth segment and space segment of satellite communication.
CO6	Examine satellite mobile and specialized services.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**FUNDAMENTALS OF SATELLITE AND PROPAGATION IMPAIRMENTS** Introduction, frequency allocation, INTELSAT, Indian Satellite systems. PROPAGATION IMPAIRMENTS: Introduction, atmospheric loss, ionospheric Effects, rain attenuation, other propagation impairments.	9	CO1 CO2
2	**ORBITS** 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.	9	CO3 CO4
3	**SPACE SEGMENT and SPACE LINK** Introduction, power supply units, altitude control, station keeping, thermal control, TT&C Sub sytem, transponders, antenna subsystem. SPACE LINK**:** Introduction, EIRP, transmission losses, link power budget Equation, system noise, CNR, uplink and downlink, combined CNR.	9	CO2 CO5
4	**EARTH SEGEMENT** Introduction, receive only home TV system, outdoor unit, indoor unit, MATV, CATV, Tx–Rx earth station.	9	CO5

5	**DBS, SATELLITE MOBILE AND SPECIALIZED SERVICES** Introduction, orbital spacing, power ratio, frequency and polarization, transponder capacity, bit rates for digital TV, satellite mobile services, VSAT, RadarSat. GPS: Introduction, GPS position and location principles, GPS receiver and codes, Orbcomm.	9	CO6

Text Books:

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

Reference Books:

1. Satellite Communication Systems Engineering, Louis J. Ippolito Jr., 2nd edition, 2017, John Wiley & Sons Ltd.
2. Satellite Communications, Timothy Pratt, Charles Bostian and Jeremy Allnutt, 2nd Edition, 2008, John Wiley Pvt. Ltd & Sons.
3. Satellite Communication Systems Engineering, W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson, 2nd edition, 2007, Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

BIOMEDICAL SIGNAL AND IMAGE PROCESSING			
Course Code	**:ECE734**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Apply the concepts of signal processing for defining ECG and EEG Signals
CO2	Analyze the behavior and characteristics of biomedical signals
CO3	Select the relevant mathematical expression for representing biomedical signaling
CO4	Examine cardiac signal processing using detection algorithms
CO5	Analyze the rhythms and detection process in neurological signal processing
CO6	Classify medical imaging techniques in acquiring medical imaging and engage in self learning for analysing the data acquisition process in medical diagnostics examination

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction to Biomedical Signals:** The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Electrocardiography**:** Basic electrocardiography, ECG leads systems, ECG signal characteristics. Signal Conversion**:** Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.	9	CO1 CO2
2	**Signal Averaging:** Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering. 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.	9	CO2 CO3
3	**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.	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	9	CO5

	detection.		
5	**Biomedical Image Processing using CT:** Introduction, CT Instrumentation, Image Formation, Image Quality in CT. Biomedical Image Processing using Ultrasound: Introduction, Instrumentation, Pulse-Echo Imaging, Transducer Motion, Ultrasound Imaging Modes, Steering and Focusing, 3-D Ultrasound Imaging, Image Quality.	9	CO6

Text Books:

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

Reference Books:

1. Biomedical Signal Analysis, R. Rangayyan, 2015, Wiley India Private Limited.
2. Biomedical Signal Processing & Signal Modeling, Bruce, 2001, John Wiley and Sons.
3. Bioelectrical Signal Processing in Cardiac & Neurological Applications, Sörnmo, 2009, Reed Elsevier Private Limited.
4. Biosignal and Biomedical Image Processing, Semmlow, 2004, Marcel Dekker.
5. Introduction to Biomedical Engineering, Enderle, 2nd Edition, 2005, Reed Elsevier Private Limited.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

ARTIFICIAL INTELLIGENCE AND COGNITIVE COMPUTING			
Course Code	**:ECE735**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	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 weak and strong, slot and filler structures
CO5	Analyze the architecture of Cognitive computing system
CO6	Engage in self learning by performing cognitive analytics

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction:** Definition of artificial intelligence, Problems, Problem Spaces and search, Heuristic search technique.	9	CO1
2	**Knowledge Representation:** Its issues, Using Predicate Logic, Representing knowledge using Rules.	9	CO2
3	**Statistical reasoning and Slot-Filler structures:** Symbolic Reasoning under Uncertainty, Statistical reasoning, Weak Slot and Filler Structures, Strong slot-and-filler structure.	9	CO3 CO4
4	**Cognitive Computing:** Concepts, Architecture, System and Application**:** Introduction, Cognitive Computing Architecture and approaches, Cognitive computing System and Applications.	9	CO5
5	**Cognitive Analytics:** Introduction, Evolution of Analytics and Core theme, Types of Learning, Cognitive Analytics applications.	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.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

SOFTWARE DEFINED RADIO			
Course Code	**:ECE736**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Explain the concepts of software defined radio and its implementation issues
CO2	Appraise the basics of multi-rate signal processing
CO3	Compare various digital synthesis approaches
CO4	Examine the various data converter architectures and their performance
CO5	Analyze the basics of designing antenna systems to accommodate the needs of software defined radio
CO6	Propose system level decisions for software defined radio technology and products

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction to SDR:** What is a Software Radio? The need for Software Radios, Characteristics and benefits of a Software Radio, Design principles of Software Radio. Radio frequency implementation issues. 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.	9	CO1 CO6
2	**Overall performance:** Importance of the components to system performance, Transmitter architectures and their Issues, noise and distortion in the RF Chain, ADC and DAC distortion. Multirate signal processing: Introduction to sample rate conversion principles, poly phase filters, digital filter banks.	9	CO2 CO6
3	**Digital generation of signals:** 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.	9	CO3 CO6
4	**Data conversion:** 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.	9	CO4 CO6

5	**Smart antennas:** Smart antenna designing issues, Vector channel modelling, Benefits of smart antennas , Structures for beam forming systems, Smart antenna algorithms, Diversity and space-time adaptive signal processing, Algorithms for transmit STAP, Hardware Implementation of smart antennas.	9	CO5 CO6

Text Books:

1. Software Radio - A modern approach to radio engineering, Jeffery H Reed, 2002, Pearson education.

Reference Books:

1. Telecommunication Breakdown, C. Richard Johnson Jr., William A. Sethares, 2003, PHI.
2. Multi-carrier and Spread Spectrum Systems, K. Fazel, S. Kaiser, 2010, John Wiley and Sons.
3. Software Defined Radio using MATLAB and Simulink and the RH-Sdr, Robert W. Stewart, Kenneth W. Barlee, Dale S.W. Atkinson, 2015, Strathdyde Academic Media.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

ROBOTICS			
Course Code	**:ECE741**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Develop representation of robots in workspace
CO2	Solve for kinematics of robot manipulators
CO3	Plan trajectory for robot motion
CO4	Design robot using linear control methods
CO5	Select actuators, and controllers for robotic applications
CO6	Design of sensors and interfaces for industrial robots

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Introduction:** 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: Eulerangles,2 –vector representation, angle – axis representation, Euler parameters	9	CO1
2	**Forward Kinematics:** Introduction, Link description, link connection description, Denavit Hartenberg parameters, Derivation of link transformations, concatenating link transformations, actuator space, joint space and Cartesian space Inverse Kinematics: Introduction, Solvability: existence of solution, multiple solutions and method of solution; algebraic vs. geometric approach, algebraic solution by reduction to polynomial, workspace, Repeatability and accuracy	9	CO2
3	**Trajectory Generation:** Introduction, general considerations in path description and generation, Joint space schemes: cubic 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,geometricproblemswithCartesianpaths,pathgenerationatruntime	9	CO3
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 Actuators: Power conversion unit, Types of Actuators	9	CO4 CO5

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	**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., 3rd edition, 2008, Pearson Education India.
2. Robotics and Control, R. Mittle & J Nagrath, 1st edition, 2017, McGraw Hill Higher Education.

Reference Books:

1. Robotics: Fundamental concepts & analysis, Ghosal A, 2006, Oxford University Press.
2. Introduction to robotics: Analysis, systems, applications, Niku S B, 2008, Pearson Education

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

Bloom's Taxonomy	**Tests**	**Assignments**	**Quizzes**	**Self-Study**
Marks	**25**	**10**	**5**	**10**
Remember	5	-	-	5
Understand	5	5	-	5
Apply	10	5	-	-
Analyze	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.

SEE- Semester End Examination **Theory (50 Marks)**

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

LOW POWER VLSI DESIGN			
Course Code	**:ECE742**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	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

Mapping of Course Outcomes to Program Outcomes:

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

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.	9	CO1 CO6
2	**Device and Technology Impact on Low Power Electronics:** Introduction, dynamic dissipation in CMOS, Effects of V_{dd} and V_t on Speed, Constraints on reduction, Transistor sizing and Optimal Gate oxide thickness, impact of technology scaling, Technology and device innovations.	9	CO2 CO6
3	**Low Power Circuit Techniques:** Introduction, Power Consumption in Circuits, Flip Flops and latches, Logic, High Capacitance Nodes.	9	CO3 CO6
4	**Low-Power Static RAM Architectures:** 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,ReducingPowerinSenseAmplifierCircuits,MethodforAchieving Low Core Voltages from a single supply.	9	CO4 CO6
5	**Low-Energy Computing Using Energy Recovery techniques:** Energy Dissipation in Transistor Channel Using an RC Model, Energy Recovery Circuit Design, Designs with Partially Reversible Logic, Supply Clock Generation.	9	CO5 CO6

Text Books:

1. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, 2015, Wiley India Pvt. Ltd.
2. Practical Low Power Digital Low Power VLSI Design, Gary Yeap, 4th edition, 2014, Springer International Edition.

Reference Books:

1. Low Power Design Methodologies, Jan M. Rabaey, Massoud Pedram, 2nd edition, 2014, Springer Science + Business Media, LLC.
2. CMOS VLSI Design: A circuits and systems perspective, Neil H.E. Weste, David Harris, 4th Edition, 2015, Pearson.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

WIRELESS AD-HOC SENSOR NETWORKS			
Course Code	**:ECE743**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Apply the fundamental concepts of communication for ad-hoc wireless networks
CO2	Assess the different applications of various types of MAC protocols
CO3	Examine the design issues regarding ad-hoc and sensor networks
CO4	Design routing protocols for ad-hoc wireless networks
CO5	Evaluate various learning models in WSNs and routing algorithms in ad- hoc sensor networks
CO6	Evaluate SPR for mobile wireless networks and ad-hoc wireless networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**INTRODUCTION:** Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum –Radio propagation Mechanisms – Characteristics of the Wireless Channel -mobile ad hoc networks; (MANETs) and wireless sensor networks (WSNs): concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.	9	CO1
2	**MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS:** Issues in designing a MAC Protocol-Classification of MAC Protocols- Contention based protocols-Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11	9	CO2
3	**ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS:** Issues in designing a routing and Transport Layer protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing- Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.	9	CO1 CO4
4	**WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS:** Single node architecture: hardware and software components of a sensor node - WSN Network architecture: typical network architectures-data relaying and aggregation strategies -MAC layer protocols: self-organizing, Hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.	9	CO2 CO3

5	**DISTRIBUTED LEARNING** Graphical models and Fusion in WSN's, Application dependent shortest path outing in ad-hoc sensor networks, Classical Learning, Distributed learning in WSN's with a Fusion Center, Graphical Models from Sensor network fusion to graphical models. Application dependent shortest path routing in ad-hoc sensor networks, Fundamental SPR, SPR for mobile wireless networks, SPR for ad-hoc sensor networks	9	CO5 CO6

Text Books:

1. Wireless Sensor Networks – Signal Processing and Communications Perspectives, Ananthram Swami, Qing Zhao, Yao-Win Hong and Lang Tong, 1st edition, 2014, Wiley India Pvt. Ltd.
2. Ad Hoc Wireless Networks: Architectures and Protocols, C. Siva Ram Murthy and B. S. Manoj, 2008, Prentice Hall Professional Technical Reference.

Reference Books:

1. Recent development in Wireless sensor & Adhoc networks, S. Patnaik, Xialong Li, Yeon-Mo Yang, 2015, Springer.
2. Wireless Sensor Networks: Theory and Practice, W. Dargie and C Poellabauer, 1st edition, 2012, Wiley India Pvt. Ltd.
3. Wireless Sensor Networks - Technology, Protocols, and Applications Kazem Sohraby, Daniel Minoli and Taieb Znati, 2007, John Wiley.
4. Protocols and Architectures for Wireless Sensor Networks, Holger Karl and Andreas Willig, 2005, John Wiley.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

MULTIMEDIA SIGNAL PROCESSING AND CODING			
Course Code	**:ECE744**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Make use of the fundamentals of multimedia signal processing
CO2	Illustrate various models used in signal processing
CO3	Classify and Examine the different types of text coding techniques
CO4	Appraise the design of digital filter banks
CO5	Demonstrate various coding techniques for image compression
CO6	Evaluate the different video compression standards

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**MULTIMEDIA INFORMATION AND REPRESENTATION** Introduction, digital principles, text, images, audio and video	9	CO1
2	**MODEL BASED SIGNAL PROCESSING** A probability model of random signal, information model, stationary and non-stationary random processes, Wiener filter, Adaptive filter(LMS)	9	CO2
3	**TEXT COMPRESSION** Compaction techniques: Huffmann coding, Arithmetic coding, Shannon- Fano coding, Dictionary techniques, LZW algorithms.	9	CO3
4	**IMAGE COMPRESSION** Predictive techniques – DM, PCM, DPCM, Transform Coding, JPEG standards, Sub-band coding algorithms, Design of Filter banks, Wavelet based compression, Implementation using filters – EZW, SPIHT coders ,Introduction to JBIG.	9	CO4 CO5
5	**AUDIO AND VIDEO COMPRESSION** MPEG audio coding, Introduction to video compression, H.261, H.263, MPEG, MPEG-1, MPEG-2, MPEG-3, MPEG-4	9	CO6

Text Books:

1. Introduction to Multimedia and its applications, V. K. Jain, 1st edition, 2012, Khanna Book Publishing.
2. Multimedia Signal Processing: Theory and Applications in Speech, Music and Communications, Saeed V. Vaseghi, 2007, Wiley.

Reference Books:

1. Introduction to Data Compression, Khalid Sayood, 3rd edition, 2005, Morgan Kauffman Harcourt India.
2. Multimedia Communications: Applications, Networks, Protocols and Standards, Fred Halsall, 2nd edition, 2002, Pearson.
3. Multimedia Image and Video Processing, Ling Guan, Yifeng He, Sun-Yuan Kung, 2nd edition, 2017, Kindle.
4. Multimedia Information Networking, Nalin K. Sharda, 2003, PHI.
5. Multimedia Fundamentals: Vol 1 - Media Coding and Content Processing, Ralf Steinmetz, Klara Narstedt, 2004, Pearson Education.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

NEURAL NETWORKS			
Course Code	**:ECE745**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Apply neural network concepts for computation
CO2	Examine different learning algorithms for perceptron
CO3	Analyze feed forward and feed backward neural networks for pattern recognition
CO4	Build a support vector machine for pattern recognition applications
CO5	Assess the competitive learning neural networks for complex pattern recognition
CO6	Solve engineering applications based on neural networks

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Introduction to Neural Network:** Overview and fundamental concepts, Historical Development of Neural Networks, Principles, Network Architectures, Knowledge Representation, Hebbian learning, Competetive learning, Boltzmann learning, memory based learning.	9	CO1
2	**Single layer and multilayer perceptrons:** 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.	9	CO2
3	**Feed forward Neural Networks:** Introduction, Analysis of pattern Association Networks, Analysis of Pattern Classification Networks, Analysis of Pattern Mapping Networks. Feedback Neural Networks: Introduction, Analysis of Linear Auto associative FF Networks, Analysis of Pattern Storage Networks, Boltzmann Machine.	9	CO3 CO6
4	S**upport 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 perceptrons.	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.	9	CO5 CO6

Text Books:

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

Reference Books:

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

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

RENEWABLE ENERGY			
Course Code	**:ECE746**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Categorize conventional, non-conventional and hybrid sources of energy along with their features and current energy scenario
CO2	Apply the features of traditional energy systems in present context
CO3	Analyze the technologies and applications associated with Solar Thermal and Solar Photovoltaic Systems
CO4	Appraise the components of Sustainable renewable energy Systems like microhydel, Wind, Biomass and Wave.
CO5	Engage in independent study as a member of a team and make an effective oral presentation on the applications of Renewable Energy concepts
CO6	Estimate the Life Cycle Costing of sustainable hybrid energy systems.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction to Renewable Energy**: Fossil fuel based systems and its impact on society. Non-conventional energy, seasonal variations and availability. Renewable energy – sources and features. Hybrid energy systems, Distributed energy systems and dispersed generation (DG). Needs of renewable energy, its advantages and limitations, present energy scenario of conventional and renewable energy sources.	9	CO1
2	**Traditional Energy Systems:** Sources, Features and Characteristics, Applications**,** 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.	9	CO2 CO5
3	**Solar Systems:** Solar radiation spectrum. Radiation measurement, Technologies. Applications: Heating, Cooling, Drying, Distillation, Power generation. 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. Case Study: "Rural electrification programme"	9	CO3 CO5
4	**Micro-hydel, Wind, Biomass and Wave Energy:** Operating principles, Components of a micro-hydel power plant, Types and characteristics of turbines. Selection and modification. Load balancing. Wind: Wind patterns and wind data, Operating principles, Site selection, Types of	9	CO4 CO5

	windmills, Characteristics of wind generators, Load matching. Biomass: Combustion and fermentation. Anaerobic digester. Wood gasifier, Pyrolysis, Applications: Biogas, Wood stoves, Bio diesel, Combustion engine. Wave Energy: Shoreline systems, Near shore systems, Off shore systems. Case study: *"Biomass gasifier for electrification"*		
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.	9	CO5 CO6

Text Books:

1. Renewable Energy: Physics, Engineering, Environmental Impacts, Economics & Planning, 5th edition, 2017, Academic Press.
2. State of Renewable Energy in India: A Citizen's Report, Chandra Bhushan, 2014, Centre for Science and Environment.

Reference Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, 2008, McGraw-Hill Education.
2. Non-conventional energy resources, Shobh Nath Singh, 2015, Pearson India.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

INTERNET OF THINGS			
Course Code	**:ECE751**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Discover the basic concepts of Internet of Things and API's
CO2	Make use of the IoT Reference Architecture and IoT sensors
CO3	Distinguish between IoT and M2M and various network function virtualization
CO4	Inspect technological challenges faced by IoT devices and Real World Design Constraints
CO5	Build basic IoT applications on embedded platform
CO6	Design IoT applications in different domain to analyze their performance

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Introduction to IoT** Defining IoT, Characteristics of IoT, Things in IoT, Functional blocks of IoT, Communication models &APIs, IoT enabling technologies	9	CO1
2	**IoT Architecture** Introduction, State of the art, Reference Model and architecture, IoT Physical device and end point, Sensors for IoT Applications, Structureof IoT, IoT Map Device	9	CO2
3	**IoT & M2M** Machine to Machine, Difference between IoT and M2M, Software Define Network and Network Function Virtualization	9	CO3
4	**Domain specific applications of IoT** Home automation, Industry applications, Surveillance applications, Other IoT applications, Challenges in IoT, Case studies for Implanted medical devices – Bio-MEMS based applications – harvesting for RF sensors and ID tags – powering wireless SHM sensor nodes	9	CO4 CO6
5	**Developing IoTs** Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python	9	CO5 CO6

Text Books:

1. Internet of Things (A Hands-on-Approach), Vijay Madisetti and Arshdeep Bahga, 1st edition, 2014, VPT.
2. Internet of Things: Challenges, Advances and Applications, Qusay F. Hassan, Atta-Ur-Rehman Khan, Sajjad A. Madani, 2018, Chapman & Hall publishers.

Reference Books:

1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, 1st edition, 2014, Academic Press.
2. Technologies & Sensors for the Internet of Things Businesses & Market Trends 2014 – 2024, Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 2014, Yole Development Copyrights.
3. Fundamentals of Wireless Sensor Networks: Theory and Practice, Waltenegus Dargie, Christian Poellabauer, 2010, Wiley Series on Wireless Communication and Mobile Computing.
4. The Internet of Things, Samuel Greengard, 2015, The MIT press.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

VLSI DESIGN MANUFACTURING			
Course Code	**:ECE752**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Analyze the methods of fabrication techniques
CO2	Categorize the techniques involved in the VLSI fabrication process
CO3	Compare different lithography methods and etching process
CO4	Make use of deposition and diffusion mechanisms in designing VLSI systems
CO5	Analyze the fabrication of NMOS, CMOS memory and bipolar devices
CO6	Appraise the methods in assembly and packaging of VLSI devices

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Crystal growth, wafer preparation, epitaxy and oxidation** ElectronicGradeSilicon,Czochralskicrystalgrowing,SiliconShaping,processing considerations, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism and kinetics, ThinOxides, OxidationTechniquesandSystems,Oxideproperties,RedistributionofDopants at interface, Oxidation of Poly Silicon, Oxidation inducted Defects.	9	CO1 CO2
2	**Lithography and relative plasma etching** Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, reactive Plasma Etching techniques and Equipment.	9	CO1 CO3
3	**Deposition, Diffusion, Ion implementation and Metallization** Deposition process, Poly silicon, plasma assisted Deposition, Models of Diffusion in Solids, Fick's one dimensional Diffusion Equations – Atomic Diffusion Mechanism – Measurement techniques - Range theory- Implant equipment. Annealing Shallow junctions – High energy implantation – Physical vapor deposition – Patterning.	9	CO1 CO4
4	**Process simulation and VLSI process integration** Ion implantation – Diffusion and oxidation – Epitaxy – Lithography – Etching and Deposition-NMOS IC Technology–CMOS IC Technology–MOS Memory IC technology - Bipolar IC Technology – IC Fabrication.	9	CO1 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.	9	CO1 CO6

Text Books:

1. VLSI Technology, S. M. Size, 2nd edition, 2017, Mc Graw Hill.
2. Basic VLSI Design, Douglas A. Pucknell and Kamran Eshraghian, 3rd edition, 2014, PHI.

Reference Books:

1. Introduction to NMOS and CMOS VLSI System design, Amar Mukherjee, 2013, PHI.
2. Modern VLSI Design, Wayne Wolf, 1998, PHI.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

NETWORK SECURITY AND CRYPTOGRAPHY			
Course Code	**:ECE753**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Apply the classical and modern algorithms and block cipher principles to perform symmetric encryption
CO2	Apply fundamentals of secret and public cryptography and key algorithms for problem solving along with the ability of distinguishing between symmetric key and asymmetric key cryptosystems
CO3	Analyze Digital Signature and Key Distribution schemes
CO4	Identify the applications and requirements of MAC and Hash functions
CO5	Evaluate the various security designs for public networks using available secure solutions
CO6	Keep the knowledge boundaries expanded for life long learning and indulge in applications of ethical hacking for ensuring complete cyber /network security to the society

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**INTRODUCTION:** Classical Encryption techniques. BLOCK CIPHERS: Traditional Block Cipher Structure, Data Encryption Standard, Block Cipher Design Principles, Finite Field Arithmetic, Advanced Encryption Standard: Structure, Transformation Functions and Key Expansion, Modes of Operation.	9	CO1 CO2
2	**PUBLIC KEY CRYPTOGRAPHY:** Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman key Exchange, Elliptic Curve Arithmetic.	9	CO2 CO3
3	**MESSAGE AUTHENTICATION CODES AND HASH FUNCTIONS**: Message Authentication requirements, Message Authentication functions, Requirements and Security of MACs, Applications of Hash Functions, Simple Hash Functions, Requirements and Security of Hash Functions, Digital signatures.	9	CO3 CO4 CO5
4	**KEY MANAGEMENT AND DISTRIBUTION:** Symmetric Key distribution using symmetric and asymmetric encryption, Distribution of Public Keys, X.509 Certificates, Web Security, Secure Socket Layer (SSL).	9	CO2 CO3 CO5 CO6
5	**WIRELESS NETWORK SECURITY:** Wireless Security, Mobile Device security, IEEE 802.11 Wireless LAN Overview and Security, IP Security Overview.	9	CO6

Text Books:

1. Cryptography and Network Security- Principles and Practice, William Stallings, 6th edition, 2015, Pearson India**.**

Reference Books:

1. Network Security - Private Communication in a Public World, C. Kauffman, R. Perlman and M. Spencer, 2nd edition, 2002, Pearson India.
2. Cryptography and Network Security, Atul Kahate, 3rd edition, 2012, Tata McGraw Hill.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

INDUSTRIAL AUTOMATION			
Course Code	**:ECE754**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Identify potential areas for automation and justify need for automation
CO2	Select suitable major control components required to automate a process or an activity
CO3	Apply SCADA architecture and communication protocols
CO4	Organize a real time activity using modern tools and discuss the benefits of automation
CO5	Analyze the process of energy management in industries
CO6	Evaluate the energy conservation in motors, pumps, fans, compressors etc.

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction**: Automation overview, Architecture of Industrial automation systems, need for automation, Study of process flow diagrams of industrial sectors a. Thermal powerstation b. Cement industry c. Textileindustry d. pulp and paperindustry	9	CO1
2	**Automation components**: Industrial measurement systems, sensors and transducersfordifferentindustrialvariables,Studyofvariousinstruments/ instrumentation a. Temperature measurement instruments b. pressure measurement instruments c. velocity measurement instruments d. Co2, O2, Sox, Nox measurement instruments e. total dissolved solids conductivity measuring instruments	9	CO2
3	**SCADA**: Introduction to supervisory control and data acquisition (SCADA),Monitoring and supervisory functions ,Process SCADA(Supervisory control and data acquisition systems) a. Study of process and electrical SCADA systems from Masibus,Ronan, b. Schneider, Honeywell c. Wireless Sensor networks and how data is received at SCADA station d. Wireless network protocols for industrial automation purpose e. Future trends in industrial automation–Industrial Internet of Things	9	CO3 CO4

4	**Energy studies in typical process industries**: System approach and End use approachtoefficientuseofElectricity;Electricitytarifftypes;Energyauditing: Typesandobjectives-auditinstruments-ECOassessmentandEconomic methods- specific energy analysis-Minimum energy paths-consumption models-Case study.	9	CO55
5	**Utility study**: utility study in process industries and their automation a. Electric motors and variable speed drives b. Pumps c. Compressors d. Heat, ventilation and air-conditioning systems e. Furnace f. Boilers	9	CO6

Text Books:

1. Industrial Instrumentation and Control, S.K. Singh, 3rd edition, 2015, McGraw Hill.
2. Process Control Instrumentation Technology, C.D. Johnson, 8th edition, 2015, PHI.
3. Guide book 1 and 4 for National certification examination for energy managers and energy auditors.

Reference Books:

1. SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications, Stuart A. Boyer, 1999, USA.
2. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, 2013, Jaico Publishing House

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

ROUTING AND SWITCHING – 2			
Course Code	**:ECE755**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Design logically separate networks using Virtual LANs and IEEE802.1Q trunking protocol
CO2	Analyze Dynamic Host Configuration Protocol (DHCP) operation for scalable networks
CO3	Design security controls using Standard Access Control Lists and Network Address Translation for IPv4 networks
CO4	Examine the operation of VLAN trunking protocol and Spanning tree protocols for network scalability
CO5	Assess the redundancy at layer 2 and layer 3 network devices using standard protocols
CO6	Evaluate the network connectivity using EIGRP routing and engage in self learning by troubleshooting the network configurations

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**Introduction to VLAN and DHCP** Virtual LAN : VLAN Segmentation, VLAN Implementations, Inter-VLAN Routing Using Routers, Troubleshoot VLAN , Dynamic Host Configuration Protocol : DHCPv4 , DHCPv6, Troubleshoot DHCP **Hands On :** Configure a switch port to be assigned to a VLAN based on requirements. Configure a trunk port on a LAN switch. Configure legacy Inter-VLAN Routing Configure Router-on-a-Stick Inter-VLAN Routing Configure and troubleshoot a router as a DHCPv4 server. Configure a router as a DHCPv4 client. Configure stateless DHCPv6 for a small to medium-sized business. Configure stateful DHCPv6 for a small to medium-sized business.	9	CO1 CO2 CO6
2	**Access Control Lists and NAT** **Access Control List** : ACL Operation, Standard IPv4 ACLs, Troubleshoot ACLs, **NAT:** NAT Operation, Configure NAT, Troubleshoot NAT, Device Discovery, Device Management, Device Maintenance **Hands On:** Configure standard IPv4 ACLs to filter traffic to meet networking requirements. Configure a standard ACL to secure VTY access. Configure static NAT using the CLI.	9	CO3 CO6

	Configure dynamic NAT using the CLI. Configure PAT using the CLI. Configure port forwarding using the CLI.		
3	**LAN Design, Scaling VLAN & Spanning tree Protocol** **LAN Design:** Campus Wired LAN Designs, Campus Network Device Selection, **Scaling VLAN :** VTP, Extended VLANs, and DTP, Troubleshoot Multi-VLAN Issues, Layer 3 Switching, Spanning Tree Concepts, Varieties of Spanning Tree Protocols, Spanning Tree Configuration. **Hands On:** Configure extended VLANs. Configure Dynamic Trunking Protocol (DTP). Configure Inter-VLAN routing using Layer 3 switching. Troubleshoot Inter-VLAN routing in a Layer 3 switched environment Configure PVST+ in a switched LAN environment. Configure Rapid PVST+ in a switched LAN environment.	9	CO4 CO6
4	**Ether Channel , HSRP & Dynamic Routing** Link Aggregation Concepts, Link Aggregation Configuration, First Hop Redundancy Protocols, Distance Vector Dynamic Routing, Link-State Dynamic Routing, **Hands- On:** Configure link aggregation. Troubleshoot Link aggregation Configure Ether Channel Troubleshoot Ether Channel Configure and troubleshoot HSRP using Cisco IOS commands.	9	CO5 CO6
5	**Introduction to EIGRP** EIGRP Characteristics, Implement EIGRP for IPv4, EIGRP Operation, Implement EIGRP for IPv6, Tune EIGRP, Troubleshoot EIGRP **Hands- On:** Configure EIGRP for IPv4 in a small routed network. Verify EIGRP for IPv4 operation in a small routed network. Configure EIGRP for IPv6 in a small routed network. Verify EIGRP for IPv6 implementation in a small routed network. Configure EIGRP auto summarization. Configure a router to propagate a default route in an EIGRP network. Configure EIGRP interface settings to improve network performance. Troubleshoot neighbor adjacency issues in an EIGRP network. **Troubleshoot missing route entries in an EIGRP routing table.**	9	CO6

Text Book:

1. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher.

Reference Books:

1. CCNA v2.0 R&S Lab Workbook 200-120.
2. CISCO CCNA Routing and Switching , CISCO Press ,ICND2 200-101
3. Computer Networks, Andrew S. Tanenbaum, Fourth Edition Pearson Education
4. Data Communications and Networking, Behrouz A.Forouzan, Tata McGraw Hill, 4th Edition

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	-
Understand	-
Apply	10
Analyze	40
Evaluate	-
Create	-

AUTOMOTIVE ELECTRONICS			
Course Code	**:ECE756**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Adapt the fundamentals of automotive electronics to build the advanced systems
CO2	Apply the control system approach in automotive electronics and analyze the features of digital control systems
CO3	Utilize sensors and actuators in automotive control systems design
CO4	Compare and choose an appropriate automotive buses based on application
CO5	Develop ability to perform various diagnosis towards automotive electronics
CO6	Explore and propose future automotive electronic systems

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	Cos
1	**Fundamentals of Automotive electronics:** Evolution of Electronics in Automotive, The automobile physical configuration: Engines, Ignition System, Ignition Timing, Drivetrain, Suspension, Brakes, Steering Systems.	9	CO1
2	**Control System approach in Automotive electronics:** Concept of an electronic engine control system, Definition of general terms and Engine performanceterms,Enginemapping,Controlstrategy,Electronicfuelcontrol system. Digital Engine control systems: Digital Engine control features, Fuel Control, EGR control, Variable valve timing control, Electronic ignition control	9	CO2
3	**Sensors & Actuators for automotive electronics:** Sensors: Airflow Rate, Engine Crankshaft, Throttle angle, Temperature, Feedback control Sensors Actuators: Automotive Engine Control Actuators, Fuel Injection, Exhaust gas recirculation actuator.	9	CO3
4	**Vehicle Motion Control:** Typical cruise control system, Digital cruise control system, Cruise control electronics, Antilock brake system. Automotive Buses: CAN, LIN, Flexray, MOST	9	CO4
5	**Diagnostics & Future Automotive Electronic Systems:** Diagnostics: Electronic control system diagnostics, on-board, off-board diagnosis Future Automotive Electronic Systems: Electric & Hybrid Vehicles, Fuel cell powered cars, Transmission control,Collision Avoidance Radar warning systems.	9	CO5 CO6

Text Books:

1. Understanding Automotive Electronics, Willaim B. Ribbens, 8th edition, 2017, Elsevier Science.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, 2007, John Wiley& Sons Inc.

Reference Books:

1. Automotive Electronics Hand book, Ronald K. Jurgen, 2nd edition, 1999, Mc Graw Hill.
2. Automotive Technology: Principles, diagnosis & service, Halderman J. D., 5th edition, 2016, Pearson.

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

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

New Horizon College of Engineering, Bangalore

B.E. Program - Batch: 2015 -2019

Department of Electronics and Communication Engineering

Academic Year: 2018 – 2019

Syllabus of Eighth Semester

Sl. No.	Course code	Course title	Credit Distribution				Overall credits	Theory hours	Lab hours	Marks		
			L	P	T	S				CIE	SEE	Total
1	ECE81	Routing and Switching-03	3	0	0	1	4	3	0	50	50	100
2	ECE82	Internship	0	4	0	0	4	0	0	50	50	100
2	ECE83	Project Phase – I	0	1	0	0	1	0	4	25	25	50
3	ECE84	Project Phase – II	0	1	0	0	1	0	4	25	25	50
4	ECE85	Project Phase – III	0	10	0	0	10	0	12	100	100	200
TOTAL							**20**	**3**	**20**	**250**	**250**	**500**

ROUTING AND SWITCHING-03			
Course Code	**:ECE81**	**Credits**	**:04**
L: P: T: S	**:3:0:0:1**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

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

CO1	Configure and troubleshoot advanced operations of routers and Implement OSPF routing protocols for IPv4 and IPv6
CO2	Configure the operations and benefits of WAN, WAN Authentication Protococol, virtual private networks (VPNs) and tunnelling, BGP routing protocol
CO3	Adapt the networking concept on home network for life long learning, ethical and environmental susitainability
CO4	Configure and troubleshoot advanced operation of ACL and implement standard ACL, Extended ACL for IPv4 and IPv6
CO5	Adapt the switching concept on Cisco Switch 2960 and routing concept on Cisco Router 1941
CO6	Create real LAN networking scenereo with Cisco router 1941 and Cisco Switch 2960

Mapping of Course Outcomes to Program Outcomes:

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

Module No	Module Contents	Hrs.	COs
1	**OSPF Configuration :Single-Area OSPF & Multiarea OSPF:** Single-Area OSPF : OSPF Operation, Varieties of Spanning Tree Protocols, Implement single-area OSPFv3, Multiarea OSPF : Multiarea OSPF Operation, Implement Multiarea OSPF, OSPF Tuning and Troubleshooting: Advanced Single-Area OSPF Configurations, Troubleshooting Single-Area OSPF Implementations **Hands On :** Configure single-area OSPFv3 and Verify single-area OSPFv3. Configure and verify multiarea OSPFv2 and OSPFv3 in a routed network. Configure OSPF to propagate a default route. Troubleshoot missing route entries in the single-area OSPFv2 and OSPFv3 routing table. Troubleshoot missing route entries in multiarea OSPFv2 and OSPFv3 routing tables.	9	CO1
2	**WAN Concepts ,Point to Point Connection & Branch Connections** : WAN : WAN Technologies Overview , Selecting a WAN Technology, Serial Point-to-Point Overview, PPP Operation, PPP Implementation Remote Access Connections, PPPoE, VPNs, GRE tunnel., eBGP in a single-homed remote access network. **Hands On :** Configure PPP encapsulation. Troubleshoot PPP using show and debug commands. Configure PPP authentication. Configure an eBGP branch connection. Troubleshoot a site-to-site GRE tunnel	9	CO2 CO3

3	**Access Control List**: Standard ACL Operation and Configuration, Extended IPv4 ACLs, IPv6 ACLs, Troubleshoot ACLs **Hands On:** Configure standard IPv4 ACLs to filter traffic in a small to medium-sized business network. Configure extended IPv4 ACLs to filter traffic according to networking requirements. Configure IPv6 ACLs to filter traffic according to networking requirements. Troubleshoot common ACL errors using CLI commands.	9	CO4
4	**Switch Physical Device**: Procedure to work on Switch Physical Device, Procedure to install and use Putty software. **Hands- On:** Basic Configuration on Switch Physical Device SVI Configuration on Switch and verify the connectivity Telnet and SSH Configuration on Switch Physical Device Switchport Security Configuration on Physical Device VTP, DTP and VLAN Configuration on Physical Device	9	CO3 CO5
5	**Router Physical Device:** Procedure to work on Router Physical Device, Procedure to use crimping tool to make straight through and Crossover cable. Procedure to Assign IPv4 and IPv6 Address manually to PC. **Hands- On:** Basic Configuration on Router Physical Device Assign IPv4 address to router interface and verify the connectivity Telnet and SSH Configuration on router Physical Device DHCP Configuration on Router Physical Device Static Routing Configuration on Physical Device Dynamic Routing Configuration (RIP/EGIRP/OSPF) on Physical Device Named ACL and Numbered ACL Configuration	9	CO3 CO6

Text Books:

1. CCNA Routing and Switching – Todd Lammle, 2nd Edition, Sybex Publisher.

Reference books:

1. CCNA v2.0 R&S Lab Workbook 200-120.
2. CISCO CCNA Routing and Switching , CISCO Press ,ICND2 200-101
3. Computer Networks, Andrew S. Tanenbaum, Fourth Edition Pearson Education
4. Data Communications and Networking, Behrouz A.Forouzan, Tata McGraw Hill, 4th Edition

Assessment Pattern

CIE- Continuous Internal Evaluation

Theory (50 Marks)

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

SEE- Semester End Examination

Theory (50 Marks)

Bloom's Taxonomy	Tests
Marks	**50**
Remember	-
Understand	-
Apply	20
Analyze	30
Evaluate	-
Create	-

Internship			
Course Code	**:ECE82**	**Credits**	**:04**
L: P: T: S	**:0:4:0:0**	**CIE Marks**	**:50**
Exam Hours	**:03**	**SEE Marks**	**:50**

The student will have the ability to

	Course outcomes
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:

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

Project Phase-III			
Course Code	**:ECE85**	**Credits**	**:04**
L: P: T: S	**:0:10:0:0**	**CIE Marks**	**:100**
Exam Hours	**:03**	**SEE Marks**	**:150**

The student will have the ability to

	Course outcomes
CO1	Engage in independent study to research literature and consolidate the literature review to identify and formulate the engineering problem
CO2	Apply the identified concept and engineering tools to arrive at design solutions for identified problem
CO3	Select tools/component for solving the proposed problem and perform budget analysis of the project
CO4	Analyze the results of experiments conducted on the design solution to draw valid conclusions
CO5	Identify the community that shall benefit through the solution and also demonstrate concern for environment through prescribed standards/safety norms
CO6	Perform in team and engage in effective written and oral communication through project report/video about the project

Mapping of Course Outcomes to Program Outcomes:

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

APPENDIX A

Outcome Based Education

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

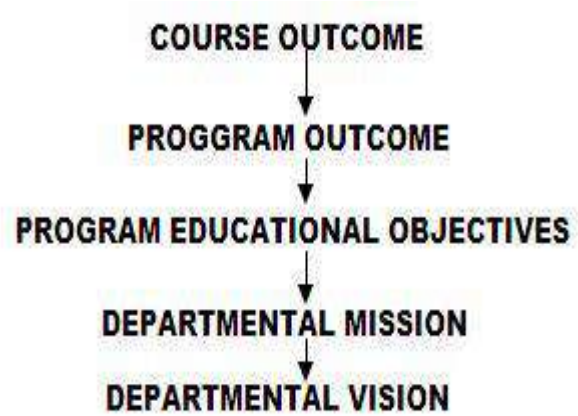
There are three educational Outcomes as defined by the National Board of Accreditation:

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

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

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

Mapping of Outcomes



APPENDIX B

The Graduate Attributes of NBA

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

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

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

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

The engineer and society: Apply reasoning informed by the contextual knowledge to asses ssocietal, 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 evels 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.