DEPARTMENT OF ELECTRONICS ANDCOMMUNICATION ENGINEERING

CURRICULUM

FOR THE ACADEMIC YEAR 2019-2023

VII and VIII SEMESTER B.E

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING
(An autonomous college Affiliated to VTU Belagavi)
KALABURAGI

About the Institution

The Hyderabad Karnataka Education (HKE) society founded by LateShriMahadevappaRampure, a great visionary and educationist.The HKE Society runs 46 educational institutions. PoojyaDoddappaAppa College of Engineering, Gulbarga is the first institution established by the society in1958.The college is celebrating its golden jubilee year, setting new standards in the field of educationand achieving greater heights.

About the department

Department of Electronics & Communication Engineering was established in 1967 & is the pride of Karnataka. With an initial intake of 30 students the department has grown steadily and the present intake is 120 students for the UG programme. The graduates from this Department are playing a vital role in the IT revolution and are instrumental in placing Karnataka on the Global IT Landscape. These professionals have found placement in major industries and multinational corporations. Many of them are successful entrepreneurs.

The department also offers Post Graduate programs in 'Communication Systems' with an intake of 18. Active engagement of faculty in research has led to recognition of department as a Research center by theVTU.

The faculty strength of the department is 28, including 4 Professors, 4 Associate Professors, 20 Assistant Professors. The faculty always strives for imparting better knowledge to the students and works as a team in all departmental activities.

Students graduated from the department are well placed in India and abroad. Quite a few of them have pursued higher studies both in India and abroad. Some of them have qualified for Indian Engineering and Defense Services. Students of the department have bagged university ranks including the First rank on several occasions.

The department has state-of-the-art laboratories in the areas of Communication, DSP, Microwave, Microcontroller, Embedded system, VLSI design etc.

Vision of the Institute

To be an institute of excellence in technical education and research to serve the needs of industry and society at local and global levels.

Mission of the Institute

1. To provide a high-quality educational experience for students with values and ethics that enables them to become leaders in their chosen profession.
2. To explore, create and develop innovations in engineering and science through research and developmental activities.
3. To provide beneficial service to national and multinational industries and communities through educational, technical and professional activities.

Department of Electronics and Communication Engineering

Vision of the Department

To be a premier department in Electronics and Communication Engineering field by providing quality education through teaching, learning, research and innovations to serve the industry and society.

Mission of the Department

M1 Develop an environment for better teaching and learning in collaboration with industry, premier institutes and alumni.

M2 Produce competent engineers to meet the requirements of the industry and the society.

M3 Encourage students to pursue higher education, research work and to take up administrative responsibilities through leadership.

Program Educational Objectives

1. The graduates possess emergent technical skills to perform design and developmental activities in various areas of Electronics and Communication Engineering like Signal Processing, VLSI, Embedded Systems, Communication Systems and other engineering specializations.
2. The graduates indulge into entrepreneurial, higher learning/research activities to be in pace with the continuous developing environment.
3. The graduates exhibit effective communication skills, leadership and team work qualities in industry, research and development organizations maintaining ethical standards.

Program Outcomes:

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

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

3. 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.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data,and synthesis of the information to provide valid conclusions.

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

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

7. 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.

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

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

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

11. Project management and finance: Demonstrate knowledge and understanding of 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: Recognize the need for, and have the preparation and ability toengage in independent and life-long learning in the broadest context of technological change.

PSO-Program Specific Outcomes:

1. Apply the concepts of Electronics & Communication Engineering in various areas like Signal processing, VLSI, Embedded systems, Communication Systems, Digital & Analog Devices and other engineering specializations.

2. Solve complex Electronics and Communication Engineering problems with modern hardware and software tools, along with analytical skills to arrive at cost effective and appropriate solutions.

3. Possess social and environmental awareness along with ethical responsibility to adapt with the emerging technologies in Electronics and Communication Engineering for sustainable real-world applications to have a successful career.

Scheme of Teaching and Examination of VII Semester B.E in Electronics and Communication Engineering

Code	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
19EC71	VLSI Design	03	--	--	03	50	50	100	3
19EC72	Microwave and Radar	03	--	--	03	50	50	100	3
19EC73x	Elective-2	03	--	--	03	50	50	100	3
19EC74x	Elective-3	03	--	--	03	50	50	100	3
19EC7OE	Open Elective	03	--	--	03	50	50	100	3
19ECL71	VLSI Lab	--	--	02	02	50	50	100	1
19ECL72	Microwave Communication Lab	--	--	02	02	50	50	100	1
19ECP73	Project phase-I	--	--	06	06	50	50	100	3
		16	--	12	28	400	400	800	20

Elective 2: (VII Sem)	**Elective 3: (VII Sem)**
19EC731:Artificial Intelligence & Machine Learning 19EC732: Python and Shell Scripting 19EC733: Multimedia Communication	19EC741: Satellite Communication 19EC742: Wireless Communication 19EC743: Wavelet Transforms
Open Elective (VII Sem)	
19EC7OE1:Optimization Techniques 19EC7OE2:Adaptive Signal Processing 19EC7OE3: Speech Signal Processing	

Scheme of Teaching and Examination of VIII Semester B.E in Electronics and Communication Engineering

Code	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
19EC81	Computer Communication and Networking	03	--	--	04	50	50	100	3
19EC82x	Elective-4	03	--	--	04	50	50	100	3
19EC8OEx	Open Elective	03	--	--	04	50	50	100	3
19ECMC85	Certification Course(NPTEL/ MOOC)	--	--	--	--	--	--	--	1
19ECP81	Project Phase-II	--	--	03	03	50	50	100	12
19ECS81	Seminar	--	--	--	--	50	50	100	1
18ECIN81	Internship	--	--	--	--	--	--	--	2
		10	--	01	15	250	250	500	25

Elective 4: (VIII Sem)	**Open Elective: (VIII Sem)**
19EC821: Digital Image Processing 19EC822: Optical Fiber Communication 19EC823: Low Power VLSI	19EC8OE1: Internet of Things 19EC8OE2: Wireless Sensor Networks 19EC8OE3:Cryptography and Network Security

VLSI DESIGN		
Subject Code	19EC71	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

The objectives of the course is to enable students to:

- Impart knowledge of MOS transistor theory and CMOS technologies
- Impart knowledge on architectural choices and performance tradeoffs involved in designingand realizing the circuits in CMOS technology
- Cultivate the concepts of subsystem design processes
- Demonstrate the concepts of CMOS testing

Modules-1	Teaching Hours
Introduction: A Brief History, MOS Transistors, MOS Transistor Theory, Ideal I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics. MOS Device Design Equations. **Fabrication:** nMOS Fabrication, CMOS Fabrication [P-well process, N-well process, Twin tub process, BiCMOS Technology.	**9 Hours**
Modules-2	
Circuit Design Processes: MOS layers. Stick Diagrams. Design rules and layout – lambda-based design and otherrules. **Logic Design with MOSFET:** Basic logic gates and complex logic gates in CMOS, Transmission gates circuits, CMOS Design rules and NMOS Design rules.	**9 Hours**
Modules-3	
Basic Circuit Concepts: Sheet resistance. Area capacitances. Capacitance calculations. The delay unit, Inverter delays. Driving capacitive loads. Propagation delays. Wiring capacitances. **Scaling of MOS circuits:** Scaling models and scaling factors. Limits on scaling.	**8 Hours**
Modules-4	
Subsystem Designs: Some Architectural Issues, Switch Logic, Gate(restoring) Logic, Parity Generators, Multiplexers, The Programmable Logic Array (PLA) **Subsystem Design Processes:** Some General considerations, An illustration of Design Processes.	**8 Hours**
Modules-5	
Memory, Registers and Aspects of system Timing- System Timing Considerations, Some commonly used Storage/Memory elements. (Self study) **Testing and Verification:** Introduction, Logic Verification, Logic Verification Principles, Manufacturing Test Principles, Design for testability.	**8 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20 marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. **Basic VLSI Design –** Douglas A Pucknell& Kamran Eshraghian,PHI 3rd Edition (original Edition – 1994), 2005.
2. **Principles of CMOS VLSI Design: A Systems Perspective,** Neil H. E. Westeand K. Eshragian, 2nd edition, Pearson Education (Asia Pvt. Ltd., 2000.) McGraw-Hill Publishing Co.Ltd.
3. **Introduction to VLSI circuits & systems,** John P.Uymeura

Reference Books:

1. **CMOS Digital 4Integrated Circuits: Analysis and Design,** Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.
2. **Analysis and Design of Digital Integrated Circuits** – D.A Hodges,H.G Jackson and R.A Saleh 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
19EC71	CO1	Understand and analyze MOS transistor theory and fabrication process.
	CO2	Design MOS circuits using stick and layout diagrams.
	CO3	Analyze CMOS fabrication flow and technology scaling
	CO4	Analyze CMOS subsystems and architectural issue with the design constraints
	CO5	Analyze Memory elements and testability issues in VLSI Design

Course with course code: VLSI Design 19EC71

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand and analyze MOS transistor theory and fabrication process.	3	2	2									1	3		3
CO2	Design MOS circuits using stick and layout diagrams.	2	3	3		3							1	3	2	3
CO3	Analyze CMOS fabrication flow and technology scaling	2	3	2		3							1	3	2	3
CO4	Analyze CMOS subsystems and architectural issue with the design constraints	3	3	2									1	3	2	3
CO5	Analyze Memory elements and testability issues in VLSI Design	3	2	2									1	3	2	3
	Average	2.6	2.6	2.2		3							1	3	2	3

MICROWAVES AND RADAR		
Subject Code	19EC72	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Learning Objectives:

To enable the students to obtain the knowledge of Microwave & RADAR:

- Understand the basic concepts of Active& Passive Devices.
- Learn & analyze the Detection of RADAR.
- Analyze the functional aspects of moving target indicator & pulse Doppler RADAR.
- Introduce different types of RADAR Antenna & Tracking Techniques.

Modules-1	Teaching Hours
MICROWAVE WAVEGUIDES AND COMPONENTS: Introduction, hybrid circuits, directional couplers, circulators, magic tee and isolators, phase shifters, attenuators, s-matrix representation of multiport networks.	**09 Hours**
Modules-2	
MICROWAVE DIODES: Transfer electron devices: Introduction: Avalanche transit time devices:READ diode, IMPATT diode, BARITT diode, parametric amplifiersand other diodes: PIN diodes, Schottky diodes. GUNN effect diodes – GaAs diodes, RWH theory, Modes of operation.	**09 Hours**
Modules-3	
RADAR: Principle, RADAR Range equation, applications, detection of signals in noise, receiver noise & signal – to- noise ratio, probabilities of detection of false alarm, probability of detection, radar cross section of targets, simple & complex targets, transmitter power, pulse repetition frequency & range ambiguities, system losses.	**08 Hours**
Modules-4	
MTI & PULSE DOPPLER RADAR: Introduction, simple CW Doppler radar, pulse radar that extracts Doppler frequency shifted echo signal, sweep to sweep subtraction & delay line canceller, MTI Radar block diagram, frequency response of single delay line canceller, blind speeds, clutter attenuation, MTI improvement factor, digital MTI processing, blind phases, I & Q channel, moving target detector.	**08 Hours**
Modules-5	
TRACKING WITH RADAR: Types of Tracking radar, monopulse tracking, conical scan & sequential lobing, tracking in range. **RADAR ANTENNAS**: Reflector antennas, electronically steered phased array antennas, phase shifters, frequency scan arrays, radiators for phased arrays.	**08 Hours**

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20marks.
- There will be 2 full questions (with a maximum of four subquestions)from each module.
- Each full question will have sub questions covering all the topicsunder a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. Introduction to Radar Systems – Merrill I Skolnik, 3rd Ed,TMH, 2001.
2. Microwave Engineering – Annapurna Das, Sisir K Das TMHPublication, 2001.

Reference Books:

1. Microwave Devices and Circuits – Liao / Pearson Education.
2. Microwave Engineering – David M Pozar, John Wiley, 2E,2004.

E books and online course materials:

1. https://www.nap.edu/read/2266/chapter/4
2. https://www.radartutorial.eu/01.basics/Radar%20Principle.en.html

Course outcomes:
On completion of the course, the student will have the ability to:

	CO #	Course Outcome (CO)
Course Code 19EC72	**CO1**	Analyze passive devices and their applications.
	CO2	Analyze the characteristics of active devices.
	CO3	Analyze the detection of RADAR.
	CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar.
	CO5	Analyze different Radar Antenna and different techniques for Tracking.

Course with course code: Microwaves and Radar(19EC72)

CO #	Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze passive devices and their applications.	2	1	1	1								1	2	1	1
CO2	Analyze the characteristics of active devices.	2	1	1	1								1	2	1	1
CO3	Determine target and its range.	1	2	1			1	1			2	1	1	2	1	1
CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar.	1	2	2	1		1	1			2			1	2	1
CO5	Analyze different Radar Antenna and different techniques for Tracking.	1	2	2	1								1	2	2	1
	Average	1.4	1.6	1.4	1		1	1			2	1	1	1.8	1.6	1

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING		
Subject Code	19EC731	CIE: 50
Number of Lecture Hours/Week	03 Hours(Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- To impart the knowledge about the concept of AI and machine learning
- To understand the concepts of computing environment
- To build the foundation of deep learning and neural networks
- To enable students to develop successful machine learning projects

Modules-1	**Teaching Hours**
Introduction to AI: Intelligent agents, agents and environment, the concepts of rationality, AI Problems as NP, NP complete hard problems, strong and weak, neat and scruffy, symbolic and sub symbolic, knowledge based and data driven AI. Problem solving methods – Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraint's satisfaction – Related algorithms, Measure of performance and analysis of search algorithms	**09 Hours**
Modules-2	
Game playing and Knowledge representation: Game playing-minmax, alpha-beta, knowledge representation and reasoning-building a knowledge base, first order logic, propositional and predicate logic, temporal and spatial reasoning logic, probabilistic reasoning, Resolution and theorem proving, Bayes theorem.	**08 Hours**
Modules-3	
Planning and learning: Basic plan generation systems-strips, Advanced plan generation systems-K strips, goal stak planning, non-linear planning, Hierarchical planning. Learning from example, learning by advice, explanation-based learning, learning in problem solving	**08 Hours**
Modules-4	
Machine Learning: Basics of machine learning-Supervised and unsupervised learning, Learning from reinforcement, selection of appropriate algorithm Fuzzy logic and fuzzy reasoning, applications	**09 Hours**
Modules-5	
Introduction to deep learning: Deep learning overview, applications of deep learning in artificial intelligence, Algorithms in deep learning, comparison of machine learning and deep learning-data dependencies, hardware dependencies, execution time, interpretability.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions,selecting one full question from each module.

Text books:

1. Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence(SIE)",McGraw Hill-2008.

Reference Books:

1. Dan W Patterson, " Introduction to AI and ES", Pearson Education, 2007
2. N.P Padhy, S.P Simon," Soft Computing with MATLAB Programming", Oxford University Press-2015

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Outcomes	CO #	Course Outcome (CO)
19EC731	**CO1**	Learning the fundamental principles of Artificial intelligence and machine learning
	CO2	Identify the principle of uncertainty and reasoning under uncertainty
	CO3	Identify various optimization techniques and applications of neural networks.
	CO4	Identify learning algorithms for various types of learning tasks in various domains
	CO5	Implement deep learning algorithms and solve real world problems

Course with course code: Artificial Intelligence and Machine Learning 19EC731

		PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Learning the fundamental principles of Artificial intelligence and machine learning	3	2										1	3	2	1
CO2	Identify the principle of uncertainty and reasoning under uncertainty	3	3	2									1	3	2	1
CO3	Identify various optimization techniques and applications of neural networks.	3	2	2									1	3	2	1
CO4	Identify learning algorithms for various types of learning tasks in various domains	3	2	2									1	3	2	1
CO5	Implement deep learning algorithms and solve real world problems	3	2	2									1	3	2	1
	Average	3	2.2	2									1	3	2	1

PYTHON AND SHELL SCRIPTING		
Subject Code:	19EC732	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
	Credits: 3:0:0:3	

Prerequisite: The students should have the basic knowledge of C and C++.

Course Objectives:

To enable the students to obtain the knowledge of Programming Python With Unix Systems to:

- Understand the basic principles of Python programs and IDEAL environment.
- Understand the control and loop structures in Python and string and file handling mechanisms.
- Understand the concepts of objects and modular design in python.
- Understand OOPs in python and build GUI applications.
- Understand the UNIX environment, File System, shell scripting and administrative privileges.

Modules	Teaching Hours
Module I	**8 Hours**
Python Programming Language- About Python, Python development environment, programming fundamental concepts, Literals, Strings, Control Structure, String Formatting, Variables and Identifiers, Operators, Expression and Data types, Control Structures, Boolean Expressions, Selection control, Iterative Control	
Module II	**9 Hours**
Lists in python, List structure, List operations, List traversal, Lists sequence in python, Tuples, Sequences, and Nested Lists, loop statements in python, List Assigning and Copying List comprehension. **Functions:** Functions in python, Types of functions, Parameter passing in function. Examples on loop, decision constructs and functions using python shell.	
Module III	**8Hours**
Objects in python: Objects and their use, Object references, Turtle graphics, Creating turtle graphics, Fundamental and Additional turtle attributes, Creating multiple turtles. **Modular design-**Modules and module specifications, Python modules, name spaces, Importing Modules, Module Loading and execution, local, Global and built-in namespaces, text files, string processing, Exceptional handling in Python.	
Module IV	**8 Hours**
Object oriented programming:OOPs in python, Class, fundamental features of OOPS, Encapsulation, Inheritance, Polymorphism. **GUI Programming-** Introduction, Tkinter programming, Designer Attributes, Tkinter widgets, Project Development using Python Modules.	
Module V	

UNIX : The UNIX Environment, UNIX Structure, Commands, File Systems- Operations on Directories and Regular Files, Security and File Permission - **Vi Editor - The Basic vi Editor and its operations** **Itroduction to Shells-** Unix Session , Standard Streams , Redirection, Pipes , tee command, Command execution , Quotes , Command substitution, Job Control, Aliases, Variables, predefined variables, Options, Shell/Environment Customization. **Shell Programming –** Basic Script Concepts, Expressions, Decisions: Making Selections, Repetition, Special Parameters and variables, Changing Positional Parameters, Argument Validation, Debugging Scripts, Script Examples.	**9 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. Charles Dierbach, Introduction to Computer Science using PYTHON - A Computational Problem -Solving Focus, Wiley India Edition
2. Sumitabha Das, UNIX Concepts and Applications Fourth Edition, Tata McGraw Hill Publications, 2009.

Reference Books:

1. Reference Books: 1. Kenneth A. Lambert , B.L Juneja , "Fundamentals of Python Programming", Cengage Learning,ISBN:978- 81-315-2903-4, 2015

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Outcomes	CO #	Course Outcome (CO)
19EC732	**CO1**	Demonstrate the working of Python Programming Principles
	CO2	Analyze the working principles of lists, tuples and functions
	CO3	Illustrate Objects and Modular design using python
	CO4	Implement Object Oriented Programming Principles in Python and build GUI applications
	CO5	Demonstrate the working of Unix Operating System and Categorize the concepts of Shell and implement different commands and scripts in shell

Course with course code: Python and Shell Scripting 19EC732

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Demonstrate the working of Python Programming Principles	2	2	1									1	2	3	
CO2	Analyze the working principles of lists, tuples and functions	2	3	1		2							1	3	2	2
CO3	Illustrate Objects and Modular design using python	2	3	2		2							1	3	2	2
CO4	Implement Object Oriented Programming Principles in Python and build GUI applications	3	3	2		3							1	3	3	2
CO5	Demonstrate the working of Unix Operating System and Categorize the concepts of Shell and implement different commands and scripts in shell	3	3	3		3							1	3	3	
		2.4	2.8	1.8		2.5							1	3	2.6	2

MULTIMEDIA COMMUNICATION		
Subject Code	19EC733	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Understand multimedia communications, networks and multimedia information representation types.
- Analyse the basics of audio, video, text and image representation and processing techniques
- Acquire the basic skill of designing audio, video, text and image compression techniques.
- Understand notions of synchronization, presentation requirements and multimedia operating system.
- Study protocols and techniques for multimedia communication across networks.

Modules-1	Teaching Hours
Multimedia communications: Introduction, Multimedia Information Representation-digitization principles, Text, Images, audio, Video, Multimedia networks, Multimedia applications, Application and Networking Technology.	**08 Hours**
Modules-2	
Text compression: Introduction, Compression Principles, source Encoders and Destination decoders, Lossless and lossy Compression, Entropy Encoding and Source Encoding, Text Compression- Static and Dynamic Huffman Coding, Arithmetic Coding, Lempel- Ziv Coding, Lempel-Ziv-Welsh Coding. **Image Compression** Introduction, Image Compression- Graphics Interchange Format, Tagged Image File Format, Digitized Documents, Digitized Pictures, JPEG.	**09 Hours**
Modules-3	
Audio compression: Introduction, Audio Compression- PCM, DPCM, ADPCM, Linear Predictive Coding, Code Excited LPC, Perceptual Coding, MPEG audio Coders, Dolby Audio Coders, MIDI, Audio Synthesizers. **Video compression:** Video Compression Principles- H.261, H.263, H.264, MPEG model-MPEG Video MPEG-4, MPEG-7.	**09 Hours**
Modules-4	
Synchronization: Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, and process management techniques.	**08 Hours**
Modules-5	
Multimedia communication across networks: Layered video coding, Error resilient video coding techniques, Multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, Multimedia in mobile networks, Multimedia in broadcast networks.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. Fred Halsall, "Multimedia Communications", Pearson education, 2001.

Reference Books:

1. Raif Steinmetz, KlaraNahrstedt, "Multimedia: Computing, Communications and Applications", Pearson education, 2002.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "Multimedia Communication Systems", Pearson education, 2004.
3. John Billamil, Louis Molina, "Multimedia : An Introduction", PHI, 2002.

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Outcomes	CO #	Course Outcome (CO)
19EC733	**CO1**	Describe multimedia information representation and applications and deploy multimedia communication models.
	CO2	Develop and implement models for coding of text, speech and image.
	CO3	Evaluate the Video Compression Standards and standardization process of multimedia content.
	CO4	Identify notions of synchronization, multimedia operating systems and management techniques and develop models.
	CO5	Analyse and apply protocols and techniques for multimedia communication across networks.

Course with course code: Multimedia Communication19EC733

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	Describe multimedia information representation and applications and deploy multimedia communication models.	3	2	1										2		
CO2	Develop and implement models for coding of text, speech and image.	2	3	2									1	3	2	
CO3	Evaluate the Video Compression Standards and standardization process of multimedia content.	3	3	3									1	3	2	
CO4	Identify notions of synchronization, multimedia operating systems and management techniques and develop models.	3	3	3									1	3	3	
CO5	Analyse and apply protocols and techniques for multimedia communication across networks.	2	1	2									1	3		
	Average	2.8	2.4	2.2									1	2.8	2.33	

ADAPTIVE SIGNAL PROCESSING			
Subject Code	19EC734	CIE	50
Number of Lecture Hours/Week	3Hours (Theory)	SEE	50
Total Number of Lecture Hours	42	SEE Hours	03
CREDITS –3:0:0:3			

Course objectives: This course will enable students to:

- To study the fundamental concepts of adaptive filtering theory
- To study the stochastic process
- To study the linear optimum filter
- To study the least square and recursive least square algorithm.

Modules	Teaching Hours
Module -1	
Introduction adaptive signal processing: filtering problem, linear optimum filter, adaptive filters, linear filter structures approaches to LAF, adaptive beamforming, four classes of application **Stochastic process and models: D**iscrete time stochastic process, mean ergodic theorem, correlation matrix, stochastic models, word decomposition, autoregressive process, Yule –walker	**09 Hours**
Module -2	
Weiner filter: linear optimum filtering, principle of orthogonality, minimum mean square error, Weiner –Hopf equation, error performance surface, linear constrained minimum varience, improving coverage and capacity in cellular systems.	**08 Hours**
Module -3	
Linear prediction: Forward linear prediction, backward linear prediction, Levinson Durbin algorithm, properties of prediction error filters, Auto regressive model of stationary stochastic. **Method of steepest descent:**Basic idea, steepest descent algorithm to the weiner filter, stability of steepest descent algorithm	**08 Hours**
Module -4	
Least mean square adaptive: structure and operation of LMS algorithm, LMS adaptive algorithm, applications (adaptive noise cancellation, adaptive beam forming) **Method of least squares:**linear least square estimation problem, data windowing principle of orthogonality, minimum sum of errors squares, normal equations and linear least squares, time average correlation matrix	**09 Hours**
Module -5	
Recurssive least squares adaptive filters: preliminaries, matrix inversion lemma, exponentially weighted RLS **Kalman filters**: Recursive min mean square estimation for random variables, statement of kalman filtering problem, innovation process, estimation using innovation, filtering, initial conditions, summary of kalman filter	**08 Hours**

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20marks.
- There will be 2 full questions (with a maximum of four sub questions) fromeach module.
- Each full question will have sub questions covering all the topics under module. The students will have to answer 5 full questions, selecting one fullquestion from each module.

Text Books:

1. Simon Haykin, Adaptive filter theory, Pearson education 4th Edition-2002.

Reference Books:

1. Adaptive signal processing, Bernard Widro and Samuel strearns, Pearson education 2001

Course outcomes:
On completion of the course, the student will have the ability to:

Course outcomes	CO #	Course Outcome (CO)
19EC734	CO1	Understand the different filter structure.
	CO2	Analyze and design Weiner filter for practical applications.
	CO3	Analyze and design linear prediction filter.
	CO4	Design LMS error reduction technique.
	CO5	Understand recursive filters

Course with course code: Adaptive Signal Processing 19EC734

CO #	Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand the different filter structure.	1	3	1									2	2	1	
CO2	Analyze and design Weiner filter for practical applications.	3	3	1	1	2							2	3	3	2
CO3	Analyze and design linear prediction filter.	3	3	2	1	2							2	3	3	2
CO4	Design LMS error reduction technique.	2	3	1	1	2							2	3	3	2
CO5	Understand recursive filters	1	2	1									2	1	1	
	Average	1.8	2.8	1.2	1	2							2	2.4	2.2	2

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SATELLITE COMMUNICATION		
Subject Code	19EC741	CIE: 50
Number of Lecture Hours/Week	3 Hours(Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
	Credits – 3:0:0:3	

Course Learning Objectives:

To enable the students to obtain the knowledge on:

- Fundamental issues and concepts of satellite Communication.
- Look angles and geostationary orbits.
- Space Segment & Earth Segment.
- Satellite Link design and Budget Calculations.
- Propagation Effects and their Impact on Satellite-Earth Links.

Modules-1	Teaching Hours
Overview of satellite systems: Introduction, Basic concepts of satellite communication, Elements of satellite communication, Frequency allocation and band spectrum, active and passive satellites advantages and disadvantages of satellites, applications. **Orbital aspects of satellite communication:S**atellite orbits, orbit fundamentals, orbit mechanics, equations of the orbit, locating the satellite with respect to earth, orbital parameters ,orbital elements, Kepler's three laws of planetary motion, apogee and perigee heights.	**09 Hours**
Modules-2	
Look angle determination: The sub satellite point, elevation calculation, Azimuth calculation, orbit perturbations. **The Geostationary orbit:** Introduction, polar mount antenna, limits of visibility. Near geostationary orbits, earth eclipse of satellite, sun transit outage, launching orbits.	**08 Hours**
Modules-3	
Space Segment & Earth Segment: **The Space segment:** Introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders, antenna subsystem. **The Earth segment:** Introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station. Analysis of set top box working (Self-study)	**08 Hours**
Modules-4	
Satellite link design and Satellite access: Basic transmission theory, system noise temperature and G/T ratio; noise temperature, calculation of system noise temperature, noise figure and noise temperature G/T ratio for earth stations, Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, uplink and downlink attenuation and C/N, satellite communication link design procedure, system design examples, Ku band uplink and downlink design, rain effects at Ku band.	**08 Hours**
Modules-5	
Propagation Effects and their Impact on Satellite-Earth Links: Introduction**.** Quantifying attenuation and Depolarization, Propagation effect that are not associated with hydrometeors. Atmospheric Absorption, Tropospheric scintillation and low angle fading, Faraday rotation in the atmosphere, Ionosphere scintillation. Rain and Ice effects, Characterizing Rain, Rain drop distribution. Prediction of Rain attenuations. Prediction of XPD, rain effects on Antenna noise. Propagation impairment counter measures, Attenuation, Diversity, Depolarization.	**09 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topicsunder a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1.DennisRoddy, **"Satellite Communications",** McGraw-Hill international, 4th Edition, 2006.
2.Timothy Pratt, Charles Bostian, Jeremy Allnutt. **"Satellite Communications",** John Wiley Pvt Ltd & Sons, 2nd Edition, 2008.

Reference Books:

1. W. L. Pitchand, H. L. Suyderhoud, R.A. Nelson., **"Satellite Communication system Engineering",** Pearson Education, 2nd Edition 2007.
2. Raja Rao: **Fundamentals of Satellite communications**, PHI Learning.
3. MonojitMitra: **Satellite Communication**: PHI Learning.

E books and online course materials:

1.https://www.britannica.com/technology/satellite-communication/How-satellites-work
2.https://www.tutorialspoint.com/satellite_communication/satellite_communication_link_budget.htm

Course Code	CO #	Course Outcome (CO)
19EC741	CO1	Understand the overview of Satellite system, and orbital aspects.
	CO2	Understand the look angles and geostationary orbit.
	CO3	Understand the principle, working and operation of various subsystems of satellite as well as earth station.
	CO4	Analyze and Design satellite communication link
	CO5	Learn the Propagation Effects and their Impact on Satellite-Earth Links

Course with course code: Satellite Communication19EC741

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the overview of Satellite system, and orbital aspects.	3	1										1	2	1	-
CO2	Understand the look angles and geostationary orbit.	3	1	2									1	2	1	-
CO3	Understand the principle, working and operation of various subsystems of satellite as well as earth station.	3	2	2									1	2	1	-
CO4	Analyze and Design satellite communication link	2	2	3									1	1	2	1
CO5	Learn the Propagation Effects and their Impact on Satellite-Earth Links	2	1	1									1	1	2	1
		2.6	1.4	2									1	1.6	1.4	1

WIRELESS COMMUNICATION		
Subject Code	19EC742	CIE: 50
Number of Lecture Hours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- To introduce the concept of various wireless communication systems
- Understand the mobile radio propagation models for large scale path loss
- Describe small scale fading and multipath propagation
- Understand the modulation techniques applicable to wireless communication
- Understand equalization and diversity techniques

Modules-1	Teaching Hours
Introduction to wireless communication systems: Evolution of mobile radio communication, mobile radio telephony in US and world. Examples of Wireless communication systems, paging, cordless, and cellular telephone systems. Wireless communications systems definition and timing diagram of how a call initiated by mobile established **Modern wireless communication systems:** Evolution of 2G, 2.5G, 2.5G standards, 3G wireless networks. **Cellular concept and system design fundamentals:** Frequency reuse, channel assignment strategies, handoff strategies, Interference and system capacity, Trunk and grade of service, Improving coverage and capacity in cellular systems.	**08 Hours**
Modules-2	
Mobile radio propagation: Large scale path loss: Introduction to radio wave propagation, Free space propagation model, Relating power to electric field. Basic propagation mechanism, reflection from dielectrics, Brewster angle, Reflection from perfect conductors. Diffraction, Fresnel zone geometry, Knife edge diffraction, Scattering. Outdoor Propagation Models, Longley-Rice model, Okumura mode, Indoor Propagation model, Log distance path loss model.	**08 Hours**
Modules-3	
Mobile radio propagation: Small-scale fading and multipath: Small scale Multipath propagation, Factors influencing small scale fading, Doppler shift, Impulse response model of a multipath channel, Relationship between bandwidth and received power, Small scale multipath measurements, Direct RF pulse system, Spread spectrum sliding correlator channel sounding, Frequency domain channel sounding. Types of small scale fading: Fading Effects Due to Multipath Time Delay Spread, Flat fading, Frequency effects due to doppler spread, fast fading, Slow fading, Rayleigh and Ricean distributions	**09 Hours**
Modules-4	
Modulation Techniques for Mobile Radio: Geometric Representation of Modulation Signals, Linear Modulation Techniques, QPSK Transmission and Detection techniques, Offset QPSK, $\pi/4$ QPSK, transmission and detection techniques. Constant envelope modulation, Binary frequency shift keying, Minimum Shift keying, Gaussian Minimum Shift Keying. Combined Linear and Constant Envelope Modulation Techniques	**09 Hours**
Modules-5	
Equalization and Diversity Techniques: Equalizers in a Communications Receiver, Survey of Equalization Techniques, Linear Equalizers, Nonlinear Equalization, Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Diversity Techniques, Rake receiver,	**08 Hours**

Multiple Access Techniques for Wireless Communications: Introduction, Frequency Division Multiple Access(FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access (SSMA), Space Division Multiple Access (SDMA), Global System for Mobile (GSM)	

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. Theodore S Rappaport, Wireless Communications principles and practice, New Age Publishers 2nd Edition-2002.

Reference Books:

1. William C Y Lee. Wireless and cellular communication McGraw-Hill Professional; 2 edition

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

CO #		Course Outcome (CO)
	CO1	Understand and analyze the modern wireless communication systems and cellular concepts
	CO2	Illustrate the effects of atmosphere on radio wave propagation during large scale.
	CO3	Illustrate the effects of atmosphere on radio wave propagation during small scale fading and multipath.
	CO4	Analyze the various modulation techniques for mobile radio communication
	CO5	Analyze the various equalization and diversity techniques.

Course with course code: Wireless Communication 19EC742

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand and analyze the modern wireless communication systems and cellular concepts	03	02	01									02	03	02	
CO2	Illustrate the effects of atmosphere on radio wave propagation during large scale.	03	03	02									02	03	02	02
CO3	Illustrate the effects of atmosphere on radio wave propagation during small scale fading and multipath.	03	03	02									02	03	02	02
CO4	Analyze the various modulation techniques for mobile radio communication	03	03	02									02	03	02	02
CO5	Analyze the various equalization and diversity techniques.	03	03	02									02	03	02	02
	Average	03	2.8	1.8									02	03	02	02

Wavelet Transforms		
Subject Code	19EC743	CIE: 50
Number of Lecture Hours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Introduce the concepts of wavelet transform and continuous wavelet transform
- Understand discrete wavelet transform
- Understand theory of sideband decomposition
- Discuss real time implementation of wavelet transforms

Pre-requisite: Fundamentals of Linear Algebra: Vector spaces, Bases, Orthogonality, Projection, Orthogonal functions, Orthonormal functions, Function spaces, Signal Orthonormality and the method of finding the coefficients,

Modules-1	Teaching Hours
Signal representation using basis and frames, brief introduction to Fourier transform (FT) and Short time Fourier transform (STFT), Limitations of FT and STFT, concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's Uncertainty principle and time frequency tiling	**09 Hours**
Modules-2	
Introduction to Wavelet Transform: Why wavelet transform? Time -Frequency analysis: STFT, Gabor Transform, and Tiling in the T-F plane, examples of wavelets, Haar, MorletDaubechies, bi-orthogonal **Continuous Wavelet Transform (CWT):** Construction of continuous wavelets: Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain	**09 Hours**
Modules-3	
Discrete Wavelet Transform (DWT): Introduction, fundamentals of frame theory, wavelet frames, examples of wavelet frames, T-F localization, Orthonormal DWT, multiresolution analysis, scaling functions, construction of bases using multiresolution analysis, two-dimensional, wavelet transforms and Extensions to higher dimensions, wave packets. Fast wavelet transforms**.**Introduction to lifting functions.	**08 Hours**
Modules-4	
Theory Of Sidebands Decomposition: Introduction, multirate systems, Polyphase decomposition, two channel filter bank, biorthogonal filters, lifting schemes, M-band wavelets: multiresolution formulation, properties of M-band filter coefficients, design of 4-band symmetric orthogonal wavelet filter banks	**08 Hours**
Modules-5	
Applications of wavelets: Analysis of transient signals, Ultrasonic systems, Wavelet based feature extraction, Spectral analysis of EEG signals, Edge Detection and object isolation, Noise reduction in audio and images, Image enhancement, Speech enhancement, audio/video/image compression **Real time implementations of wavelet transforms**: VLSI implementation, optical implementation	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. AgostinoAbbate, Casimer M. DeCusatis, Pankaj K Das, "Wavelets and subbands, Fundamentals and

Applications", Second Edition, 2002.

Reference Books:

1. K.P. Soman, K.I. Ramachandran, N.G Resmi, "Insight into Wavelets from Theory to Practice" Third Edition , PHI Publication, 2010
2. StephaneMallat, "Awavelet tour of Signal Processing", Third Edition, Academic Press, 2008
3. Ingrid Daubechies", Ten Lectures on Wavelets", SIAM Philadelphia

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

CO #		Course Outcome (CO)
	CO1	The wavelet transforms to analyze the signal's regular time behavior that is either rapid or very slow
	CO2	The STFT to give information about signals simultaneously in the time domain and frequency domain
	CO3	Analyze and reconstruct signals, using the theory of generalized frames
	CO4	Perform discrete time-scale analysis and reconstruct signals as a discrete superposition of reciprocal wavelets.
	CO5	Perform discrete wavelet analysis and synthesis using recursive multi-resolution analysis with the help of orthonormal wavelets with prescribed locality and smoothness.

Course with course code: Wavelet Transforms and Its Applications19EC743

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	The wavelet transforms to analyze the signal's regular time behavior that is either rapid or very slow.		3	2						1			1	2	2	
CO2	The STFT to give information about signals simultaneously in the time domain and frequency domain.	3	2							1			1			
CO3	Analyze and reconstruct signals, using the theory of generalized frames.Recover signals using a discrete subset of nodes.	3	3	2						1			1		2	
CO4	Perform discrete time-scale analysis and reconstruct signals as a discrete superposition f reciprocal wavelets	3	3	2						1			1		2	
CO5	Perform discrete wavelet analysis and synthesis using recursive multi-resolution analysis with the help of orthonormal wavelets with prescribed locality and smoothness			3						1			1			
	Average	3	2.75	2.25						1			1	2	2	

Speech Signal Processing			
Subject Code	19EC744	CIE	50
Number of Lecture Hours/Week	03 Hours	SEE	50
Total Number of Lecture Hours	42	SEE Hours	03
CREDITS –3:0:0:3			

Course objectives: This course will enable students to:

1. To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
2. To describe basic algorithms of speech analysis common to many applications.
3. To give an overview of applications (recognition, synthesis, coding) and to inform about practical aspects of speech algorithms implementation.

Modules	Teaching Hours
Module -1	
Speech Production – human speech production mechanism, acoustic theory of speech production, digital models for speech production. Speech perception – human hearing, auditory psychophysics, JND, pitch perception, auditory masking, models for speech perception.	09 Hours
Module -2	
Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction.	08 Hours
Module -3	
Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems	08 Hours
Module -4	
Audio processing – characteristics of audio signals, sampling, Audio compression techniques, Standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications.	08 Hours
Module -5	
Speech synthesis – text to speech synthesis, letter to sound rules, syntactic analysis, timing and pitch segmental analysis. Speech recognition – Segmental feature extraction, DTW, HMMs, approaches for speaker, speech and language recognition and verification.	09 Hours

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 20marks.
- There will be 2 full questions (with a maximum of four sub questions) fromeach module.
- Each full question will have sub questions covering all the topics under module.
- The students will have to answer 5 full questions, selecting one fullquestion from each module.

Text Books:

1. Lawrence RabinerandBiing-Hwang Juang, “Fundamentals of SpeechRecognition”, Pearson Education, 2003.

Reference Books:

Daniel Jurafsky and James H Martin, “Speech and Language Processing – AnIntroduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education.

Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing.

Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
19EC733	**CO1**	Analyze mechanisms of human speech production and how the articulation mode of different classes of speech sounds determines their acoustic characteristics
	CO2	Analyze and design algorithms for extracting parameters from the speech signal.
	CO3	Analyze speech compression standards for personal communication.
	CO4	Design systems for efficient quantization and coding of speech signals.
	CO5	Analyze and Design algorithms for speech synthesis and recognition.

Course with course code: Speech Signal Processing19EC744

CO #	Course Outcome (CO)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze mechanisms of human speech production and different classes of speech sounds.	2	3		3								2	3	3	2
CO2	Analyze algorithms for extracting parameters from the speech signal.	3	2		3	3							2	3	2	1
CO3	Analyze speech compression standards for personal communication.	3	3		2	2							2	3	2	1
CO4	Design systems for efficient quantization and coding of speech signals.	3	3	2	3	3							2	3	2	2
CO5	Analyze and Design algorithms for speech synthesis and recognition.	3	3	3	3	3							2	3	2	1
		2.8	2.8	2.5	2.8	2.75							2	3	2.2	1.4

OPTIMIZATION TECHNIQUES		
Subject Code	19EC7OE	CIE: 50
Number of Lecture Hours/Week	3Hours (Theory)	SEE :50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS –3:0:0:3		

Course objectives:
The objective of this course is to introduce students to the modeling of constrained decision-making problems and optimization. This includes techniques of mathematical modeling, optimization, and sensitivity analysis.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Linear Programming: Introduction and formulation of linear programming problems, graphical solution of linear programming, simplex method, Big M method, Two Phase method.	**09 Hours**	**L1, L2,L3**
Module -2		
Linear Programming: Special cases in simplex method application. **Classical Optimization techniques**: Introduction,unconstrained and constrained problems of maxima and minima, Lagrangian method.	**09 Hours**	**L1, L2,L3**
Module -3		
Non Linear programming problems: Introduction, canonical form of non linear programming, formulation and graphical method, Kuhn-tucker conditions.	**08 Hours**	**L1, L2,L3**
Module -4		
Dynamic programming: Decision tree and Belmann principle of optimality, concept of Dynamic programming, mathematical formulation of multistage decision models.	**08 Hours**	**L1, L2,L3,L4**
Module -5		
Fundamentals of queuing system: Poisson process, birth and death process, special queuing methods.	**08 Hours**	**L1, L2,L3, L4**

Question paper pattern:
- The question paper will have ten questions.
- Each full question consists of 20marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a

module. The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS

1. S.D.Sharma, "Operations research", Kedarnath, Ramanath and Co.

Reference Books:

1. S.S Rao, " Engineering Optimization: Theory and practice", New Age International(P) Ltd., New Delhi,2000
2. G.Hadley, "Linear Programming", Narosa Publishing House,New Delhi,1990
3. H.A.Taha, "Operations research: An introduction",5th Edition, Macmillan, NewYork,1992

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
19EC7OE	**CO1**	Formulate deterministic mathematical programs in various practical systems.
	CO2	Understand basic optimization techniques.
	CO3	Interpret the results of a model and present the insights (sensitivity, duality).
	CO4	Know the limitations of different solution methodology.
	CO5	Analyse and appreciate variety of performance measures for various optimization problems

Subject with code: 19EC731: Optimization Techniques

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Formulate deterministic mathematical programs in various practical systems.	2	3	2	2	2							2	3		
CO2	Understand basic optimization techniques.	2	2	3	2	2							2	3	3	2
CO3	Interpret the results of a model and present the insights (sensitivity, duality).	3	2	3	2	2							2	2	3	2
CO4	Know the limitations of different solution methodology.	3	2	3	2	2							2	2	3	2
CO5	Analyse and appreciate variety of performance measures for various optimization problems	2	3	3	3	3							2	2	3	1
	Average	2.2	2.4	3	2.4	2.4							2	2.4	3	1.7

VLSI LAB

Subject Code	19ECL71	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours		SEE Hours: 03

CREDITS- 0:0:2:1

Course Objectives:

To enable the students to obtain the knowledge of VLSI Lab:

- Study & understand the schematic & layout of basic gates.
- Study & Analyzethe schematic& layout of combinational circuits.
- Learn &understandschematic& layout of Sequential circuits

List of experiments of the laboratory to be conducted

I. Design and develop Schematic to simulate the following

1. Inverter
2. 2- input NAND andNORgate
3. 3-input NANDand NORgate
4. Transmission Gate
5. ANDgate
6. Orgate
7. MUX/DEMUX
8. Design circuit for given expressions.

II. Draw the layout and simulate the following, also plot the transient response

1. CMOS Inverter
2. NAND
3. AND
4. OR
5. XOR
6. XNOR
7. Buffer
8. **Flip-flops**
   1. R-S
   2. D-T
   3. J-K

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script forbreakup of marks.
4. Change of experiment is allowed only once and will be evaluated for 85% of the totalmark s.

Course outcomes:

On completion of the course, the student will have the ability to:

Course Outcomes	CO #	Course Outcome (CO)
	CO1	Develop stick diagrams to simulate combinational and sequential logic circuits.
	CO2	Develop layouts to simulate combinational Logic circuits.
	CO3	Develop layouts to simulate combinational circuits using transmission gates.
	CO4	Develop layouts to simulate combinational circuits usingMOS transistor
	CO5	Develop layouts to simulate sequential circuitsusingMOS transistor.

Course with course code: VLSI Lab 19ECL71

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	Develop stick diagrams to simulate combinational and sequential logic circuits.	3	1	1	1	3				2			1	3	2	3
CO2	Develop layouts to simulate combinational Logic circuits.	3	1	1	1	3				2			1	3	2	3
CO3	Develop layoutsto simulate combinational circuits using transmission gates.	3	1	1	1	3				2			1	3	2	3
CO4	Develop layouts to simulate combinational circuits usingMOS transistor	3	1	1	1	3				2			1	3	2	3
CO5	Develop layouts to simulate sequential circuits using MOS transistor	3	1	1	1	3				2			1	3	2	3
	Average	3	1	1	1	3				2			1	3	2	3

MICROWAVE COMMUNICATION LAB

Subject Code	19ECL72	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours		SEE Hours: 03

CREDITS-0:0:2:1

Course Learning Objectives:

To enable the students to obtain the knowledge of Microwave Communication Lab:

- Study & understand the basic characteristics of Reflex Klystron.
- Study &Analyze functional characteristics of Active & Passive Devices.
- Understand & measure unknown impedance using VSWR.
- Learn & understand to draw the radiation pattern of Horn Antenna.
- Conduct an experiment on Directional coupler, power divider& Circulator using Micro strip.

List of experiments of the laboratory to be conducted

1. V-I Characteristics of Gun diode
2. Repeller mode characteristics of reflex klystron.
3. Measurement of guide wavelength and frequency.
4. Measurement of VSWR.
5. Calibration of attenuator
6. Measurement of attenuation.
7. Characteristics of directional coupler
8. Characteristics of Isolator.
9. Characteristics of Circulator.
10. Characteristics of magic tree.
11. Measurement of unknown impedance.
12. Radiation pattern of horn antenna.
13. Micro strip experiments.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and will be evaluated for 85% of the total marks.

Course outcomes:

After studying this course, students will be able to:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Outcomes	CO #	Course Outcome (CO)
	CO1	Characterize different modes of operation of active microwave devices like reflex klystron & Gunn diode.
	CO2	Analyze the functional characteristics of passive microwave devices
	CO3	Determine the radiation pattern of Horn antenna
	CO4	Determine the radiation pattern of Dipole antenna using microstrip
	CO5	Analyze functional characteristics of devices like directional coupler, power divider using microstrip

Course with course code: Microwave Communication Lab19ECL72

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Characterize different modes of operation of active microwave devices like reflex klystron & Gunn diode.	3	2		2					3			1	3	2	
CO2	Analyze the functional characteristics of passive microwave devices	1	2		2					3			1	3	2	
CO3	Determine the radiation pattern of Horn antenna	1	2	2	2					3			1	3	2	
CO4	Determine the radiation pattern of Dipole antenna using microstrip	1	2	2	2					3			1	3	2	1
CO5	Analyze functional characteristics of devices like directional coupler, power divider using microstrip	1	2	2	1					3			1	3	2	1
	Average	1.4	2	2	1.8					3			1	3	2	1

Project Phase-I		
Subject Code	19ECP73	CIE: 50
Number of Lecture Hours/Week	6	SEE: 50
Total Number of Lecture Hours		SEE Hours: 03
CREDITS- 0:0:3:3		

Course Objectives: The student will be able to

- Gain knowledge of the domain through extensive literature survey
- Define the problem and propose the methodology
- Understand and discuss budgeting
- Define the work schedule

Conduct of Project Viva Voce:

- Students should write brief description about the project
- Students should present and demonstrate the project
- Students should clarify and clear all the doubts asked by the examiner

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Perform literature survey to define the problem and state the objectives
	CO2	Propose well defined methodology
	CO3	Plan resources availability, budget and utilization
	CO4	Prepare the proposed design document and scheduling
	CO5	Present the proposed work

Course: Project Phase I (19ECP73)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Perform literature survey to define the problem and state the objectives.		2							2			2	3		2
Propose well defined methodology.	3	3					2	3	3	2	3	2	3	2	2
Plan resources availability, budget and utilization,	3	3	3	2		2	2	2	3	2		2	3	2	2
Prepare the proposed design document and scheduling.	3	3	3	3	3	2	3	2	3	2	1	2	3	2	2
Present the proposed work.	2	2	1	1	1	3	3	3	3	3	3	3	3	3	3
Average	**2.75**	**2.6**	**2.33**	**2**	**2**	**2.33**	**2.5**	**2.5**	**2.8**	**2.25**	**2.33**	**2.2**	**3**	**2.25**	**2.2**

COMPUTER COMMUNICATION NETWORKS		
Subject Code	19EC81	CIE: 50
Number ofLecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objective:

- Introduce the concept od data communication, network standards and protocols, OSI and TCP-IP models
- Understand the duties and responsibilities of data link layer and study DLL protocols
- Understand and analyze wired and wireless LANs
- Study the network layer routing protocols and addressing schemes
- Understand responsibilities and protocols of transport layer

Modules-1	Teaching Hours
INTRODUCTION: Overview of Data Communications-Components, Data Representation, Data Flow, Topology, Network Categories, Network Models, Protocols and Standards. OSI model & TCP/IP protocol suite, Addressing, Functions of Physical Layer.	**08 Hours**
Modules-2	
DATA LINK Layer: Framing, Addressing, Protocols for Noiseless & Noisy Channels. **Multiple Accesses Protocols:** Random Access protocolsand Controlled Access protocols.	**09Hours**
Modules-3	
Wired and Wireless LANs: Ethernet-IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, and Comparison. **Wireless LAN:** IEEE 802.11. Connecting Devices, Backbone Networks & Virtual LANs	**08 Hours**
Modules-4	
NETWORK LAYER: Introduction, Logical Addressing-Classful and Classless Addressing, IPv4 and IPv6protocols. Routing- Unicastand Multicast Routing Protocols.	**09 Hours**
Modules-5	
TRANSPORT LAYER: Process-to-process delivery, UDP, TCP Protocols, connection techniques. Overview of various social media platforms. ***Case Study:** Study of a practical network in your institution or any organization. ***(Not for examination)**	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students willhave to answer 5 full questionsselecting one full question from each module

Text books:

1. Data Communication & Networking, B.Forouzan, 4th Ed., TMH, 2006.
2. Computer Communication Networks, Andrew. S. Tanenbaum, 4th ED., PHI.

Reference Books:

1. Computer and Communication Networks, Nader Mir, Pearson Education,3rd Edition,2009.
2. An Engineering Approach to Computer Networking, Keshav.S, Addison Wessley Publ.

E books and online course materials:

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
	CO1	Understand the networktopologies,networkmodels, and functions of Physical Layer.
	CO2	Understand the concepts of Data Link Layer (DLL), functionalities and its protocols.
	CO3	Analyze the functioning of wired and wireless LANs.
	CO4	Understand the functions of Network Layer andits protocols.
	CO5	Understand the functions of Transport Layer and its protocols, and an overview of Upper Layers.

Subject with code: 19EC81: COMPUTER COMMUNICATION NETWORKS

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand the networktopologies,networkmodels, and functions of Physical Layer.	**3**	**2**										**1**	**3**	**2**	**1**
CO2	Understand the concepts of Data Link Layer (DLL), functionalities and its protocols.	**3**	**2**	**1**									**1**	**3**	**2**	**1**
CO3	Analyze the functioning of wired and wireless LANs.	**3**	**2**	**1**									**1**	**3**	**2**	**1**
CO4	Understand the functions of Network Layer andits protocols.	**2**	**2**	**1**									**1**	**3**	**1**	**1**
CO5	Understand the functions of Transport Layer and its protocols, and an overview of Upper Layers.	**2**	**2**	**1**									**1**	**3**	**1**	**1**
	Average	**2.6**	**2**	**1**									**1**	**3**	**1.6**	**1**

Digital Image Processing		
Subject Code	19EC821	CIE: 50
Number ofLecture Hours/Week	03 Hours(Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Introduce the concept of digital image processing
- Study the image transform and enhancement techniques
- Understand the concepts of image filtering and restoration
- Study the fundamental concepts of edge and boundary representation and image segmentation
- Study the process of color imaging and morphological image processing.

Modules-1	Teaching Hours
Digital Image Fundamentals: Introduction, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.	**09 Hours**
Modules-2	
Image Transforms: Discrete Fourier Transform,Discrete Cosine Transform,Haar Transform, Hadamard Transform. **Image Enhancement:** Enhancement by point processing, Spatial Operations, Enhancement in the frequency domain.	**08 Hours**
Modules-3	
Image Filtering and Restoration: Image observation models,Inverse and Weiner Filtering, Least squares Filters. **Fundamental Concepts of:** Edgedetection, Boundary extraction,Boundary and Region representation.	**08 Hours**
Modules-4	
Image Segmentation: Discontinuity detection, Thresholding, Region Oriented Segmentation.	**08 Hours**
Modules-5	
Color Image Processing: Color Fundamentals, Color Models, Pseudo color Processing **Morphological Image Processing:** Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to gray level images.	**09 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students willhave to answer 5 full questionsselecting one full question from each module

Text books:

1. Digital Image Processing, Rafael C.Gonzalez, Richard E. Woods, etl , TMH , 2nd Edition 2010.

Reference Books:

1. Fundamentals of Digital Image Processing, Anil K. Jain, Pearson Education, 2001.
2. Digital Image Processing and Analysis, B. Chanda and D. DuttaMajumdar, PHI, 2003.

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understand the formation and representation of images.
	CO2	Apply various transformation techniques for image enhancement.
	CO3	Implementation of image filtering and edge detection.
	CO4	Perform image segmentation using thresholding methods.
	CO5	Understand basics of color image processing and perform morphological operations.

Subject with code: Digital Image Processing 19EC821

		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	Understand the formation and representation of images.	**3**	2	2		1							1	3	2	1
CO2	Apply various transformation techniques for image enhancement.	**2**	3	2		1							1	3	2	1
CO3	Implementation of image filtering and edge detection.	**2**	3	3		1							1	3	2	1
CO4	Perform image segmentation using thresholding methods.	**2**	3	3		1							1	3	2	1
CO5	Understand basics of color image processing and perform morphological operations.	**3**	2	2		1							1	3	2	1
	Average	2.4	2.6	2.4		1							1	3	2	1

OPTICAL FIBER COMMUNICATION		
Subject Code	19EC822	CIE: 50
Number ofLecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- To learn the basic elements of optical fiber transmission link, structures and signal distortion
- To understand optical sources, materials and photo detector.
- To learn the fiber optical receivers and noise performance in photo detector.
- To learn WDM and Coherent optical systems.
- To learn SONET/SDH networks and various standards.

Modules-1	Teaching Hours
Introductions to fundamental of fiber optics, Different Generations of optical fiber communication systems, Optical fiber structure, Fiber types. Modes in optical fiber signal degradation in optical fibers, fiber losses.	**09 Hours**
Modules-2	
Optical sources, Characteristics of optical sources. LED & ILD, Light source materials. Modulation capability Photo detectors, PIN photodiode and Avalanche photodiodes, Photo detector noise	**09 Hours**
Modules-3	
Optical receiver performance calculations, Power lunching and coupling power coupling calculations, lensing schemes for coupling improvement. Fiber joints, fiber fabrication, cables and connectors, fiber splices, link Analysis and fiber codes.	**08 Hours**
Modules-4	
WDM, optical coupler and optical measurements. Coherent optical systems. Methods of modulation, Heterodyne and Homodyne systems, Noise in coherent systems Multichannel coherent systems.	**08 Hours**
Modules-5	
Introduction to light wave networks and different topologies. SONET/SDH, SONET/SDH Benefits, SONET and SDH Rates, SONET/SDH Frame.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students willhave to answer 5 full questionsselecting one full question from each module

Text books:

1. Optical fiber Communications. –GERD KEISER, 3 Edition, McGraw Hill international editions.
2. Optical fiber communications - J.M. Senior, 3 Edition, Pearson Education ltd.

Reference Books.

1. Fiber Optic Communication , Joseph C Palais, Pearson Education, 2005
2.Optical fiber & Fiber Optical Communication Systems – DrSubirKumarSarkar, S.Chand (G/L) & Company Ltd.

E books and online course materials:

1) https://onlinecourses.nptel.ac.in
2) https://nptel.ac.in/courses/117/104/117104127

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
	CO1	Understand optical fiber transmission link, fiber modes, structures and fiber losses.
	CO2	Analyze optical sources and detectors
	CO3	Understand receiver noise and coupling.
	CO4	Analyze WDM and multichannel coherent systems.
	CO5	Illustrate optical networks and understand various standards.

Subject with code: OPTICAL FIBER COMMUNICATION19EC822

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand optical fiber transmission link, fiber modes, structures and fiber losses.	3	2	1									1	3		1
CO2	Analyze optical sources and detectors	3	2	1									1	3		1
CO3	Understand receiver noise and coupling.	3	2	1									1	3	2	1
CO4	Analyze WDM and multichannel coherent systems.	3	2	1									1	3	2	1
CO5	Illustrate optical networks and understand various standards.	3	2	1									1	3	2	1
	Average	3	2	1									1	3	2	1

LOW POWER VLSI		
Subject Code	19EC823	CIE: 50
Number of Lecture Hours/Week	3 Hours(Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Introduce the concept of low power VLSI chips and device and technology impact on low power
- Understand power analysis using simulation and also with probabilistic analysis
- study simulation at various levels of design
- Understand methods to reduce power dissipation.
- Understand low power memory design and architectural methodologies.

Modules-1	Teaching Hours
Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. **Device & Technology Impact on Low Power:** Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation	**08 Hours**
Modules-2	
Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation. **Probabilistic power analysis:** Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.	**09 Hours**
Modules-3	
Low Power Circuit's: Transistor and gate sizing, network restructuring and Reorganization. Special Flip Flops & Latches design, low power digital cells library. **Logic level:** Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic.	**09 Hours**
Modules-4	
Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components **Low power Clock Distribution:** Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew.	**08 Hours**
Modules-5	
Low Power Memory Design: Introduction, Source and reductions of power dissipation in memory subsystem, Power dissipation in DRAM and SRAM **Algorithm and Architectural Level Methodologies:** Introduction, Design flow, Arithmetic level analysis and optimization, Architectural level estimation and synthesis.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students willhave to answer 5 full questionsselecting one full question from each module

Text books:

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic, 2002.
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic, 2010.

Reference Books:

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley, 2000.
2. A. P. Chandrasekaran and R. W. Broadersen, "Low Power digital CMOS design", Kluwer Academic, 1995.

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Identify sources of power dissipation in CMOS circuits
	CO2	Perform power analysis using simulation based approaches and probabilistic analysis
	CO3	Recognize role of simulation possible at various levels of design
	CO4	Analyze various methods to reduce power dissipation.
	CO5	Design low power memory devices.

Subject with code: Low Power VLSI19EC823

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Identify sources of power dissipation in CMOS circuits	3	2	1									1	3	2	
CO2	Perform power analysis using simulation based approaches and probabilistic analysis	3	3	2		1							1	3	2	1
CO3	Recognize role of simulation possible at various levels of design	3	3	2		1							1	3	2	3
CO4	Analyze various methods to reduce power dissipation.	3	3	2		1							1	3	2	3
CO5	Design low power memory devices.	3	2	2		1							1	3	2	3
	Average	3	2.6	1.8		1							1	3	2	2.5

INTERNET OF THINGS		
Subject Code	19EC8OE1	CIE: 50
Number ofLecture Hours/Week	03 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Define IOT and understand the genesis of IOT, convergence of IT and IOT
- Study architectures and Core functional stack of IOT
- Define smart objects and relate them to IOT
- Introduce the concept of IP as the Network layer for IOT
- Understand the physical devices and endpoints devices for IOT

Modules-1	Teaching Hours
What is IOT, Genesis of IOT, IOT and Digitization, IOT Impact, Convergence of IT and IOT, IOT Challenges, IOT Networks Architecture and Design, Drivers behind New Network Architectures Comparing IOT Architectures, A Simplified IOT Architectures, The core IOT Functional Stack ,IOT Data Management and Compute Stack	**08 Hours**
Modules-2	
Smart objects: The "Things" in IOT, Sensors, Actuators, and Smart objects, Sensors Network, Connecting Smart objects, Communications Criteria, IOT Access Technologies.	**08 Hours**
Modules-3	
IP as the IOT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IOT, Profile and Compliances Application Protocols for IOT, The Transport Layer, IOT Application Transport Methods.	**06 Hours**
Modules-4	
Data and Analytics for IOT: An introduction to Data Analytics for IOT, Machine learning, Big Data Analytics tool and technology, Edge streaming Analytics, Network Analytics, Securing IOTA brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary Formal Risk Analysis structures OCTAVE and FAIR, The Phased Application of Security in an Operational Environment	**10 Hours**
Modules-5	
IOT Physical Device and End points: RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Remote access to RaspberryPi via SSH, An IOT strategy for Smart Cities, Smart City IOT Architecture,Smart city Use-Case Examples	**10 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students willhave to answer 5 full questionsselecting one full question from each module

Text books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IOT Fundamentals: Networking Technologies, protocols, and Use Case for the Internet of things", 1st Edition , Pearson Education (Cisco press Indian Reprint). (ISBN: 978-9386873743)

2. Srinivasa K G, “Internet of Thongs” , CENGAGE leaning India, 2017

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-On – Approach)”, 1st Edition, VPT, 2014, (ISBN: 978-8173719547)
2. Raj Kamal, “Internet of Things: Architecture and design Principles” , 1st Edition, McGraw Hill Education,2017, (ISBN: 978-9352605224)

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Interpret the impact and challenges posed by IoT networks leading to new architectural models.
	CO2	Compare and contrast the deployment of smart objects and technologies to connect them to network.
	CO3	Understand the role of IoT protocol for efficient network communication.
	CO4	Elaborate the need for Data Analytics and Security in IoT.
	CO5	Illustrate different sensor technology for sensing real world entities and identify the applications of IoT in industry.

Subject with code: INTERNET OF THINGS 19EC8OE1

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Interpret the impact and challenges posed by IoT networks leading to new architectural models.	3	1										1	3	2	
CO2	Compare and contrast the deployment of smart objects and technologies to connect them to network.	3	2	2									1	3	2	1
CO3	Understand the role of IoT protocol for efficient network communication.	3	2	2		2							1	3	2	1
CO4	Elaborate the need for Data Analytics and Security in IoT.	3	2	2		2							1	3	2	1
CO5	Illustrate different sensor technology for sensing real world entities and identify the applications of IoT in industry.	3	2	3		2							1	3	2	3

Wireless Sensor Networks		
Subject Code	19EC8OE2	CIE: 50
Number ofLecture Hours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

- Understand the design principles of sensor networks and explore the challenges associated with it.
- Apply the Medium access control protocols and key routing protocols.
- Understand the concepts of time synchronization and network security issues.
- Understand types of programming associated with sensor networks.

Modules-1	Teaching Hours
Introduction: Network of Wireless Sensor Node, Motivation, Definitions and Background, Sensing and Sensors, Wireless Sensor Networks, Challenges and Constraints, Energy, Self-Management, Wireless Networking, Decentralized Management, Design Constraints, Other Challenges and Applications	**08 Hours**
Modules-2	
Wireless sensor Network Architectures: Single-node architecture, Hardware components, Energy consumption of sensor nodes, operating systems and execution environments, examples of sensor nodes: The "Mica Mote" family, EYES nodes, BT-nodes, Scatter web. Network Architectures: Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.	**09 Hours**
Modules-3	
MAC protocols: Fundamentals of (wireless) MAC protocols, Low duty cycle protocols and wakeup concepts, Contention-based protocols, Schedule-based protocols, The IEEE 802.15.4 MAC protocol **Network Layer**: Overview, Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.	**09 Hours**
Modules-4	
Node and Network Management: Power Management, Local Power Management Aspects, Dynamic Power Management, Conceptual Architecture. **Time Synchronization, Localization and security in Wireless Sensor Networks** : Clocks and the Synchronization Problem, Time Synchronization in Wireless Sensor Networks , Basics of Time Synchronization, Time Synchronization Protocols Localization: Overview, Ranging Techniques, Range-Based Localization, Range-Free Localization, Event-Driven Localization, Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks , Security Attacks in Sensor Networks, Protocols and Mechanisms for Security, IEEE 802.15.4 and ZigBee Security.	**08 Hours**
Modules-5	
Sensor Network Programming : Challenges in Sensor Network Programming, Node-Centric Programming: nes C Language, Tiny GALS, Sensor Network Application Construction Kit Thread-Based Model, Macro-programming, Dynamic Reprogramming, **Sensor Network Simulators**: Network Simulator Tools and Environments.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.

• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The studentswillhave to answer 5 full questions,selecting one full question from each module.

Text books:

1. WattenegusDargie and Christian Poellabauer, "Fundamentals of Wireless Sensor Networks", Theory and Practice, Wiley and sons Ltd.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.
3. KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.

Reference Books:

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach" , Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman)

E books and online course materials:

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understand principles, challenges and constraint in wireless sensor networks
	CO2	Analyze network deployment with knowledge of node and network architectures
	CO3	Analyze and evaluate the performance of different routing and MAC protocols and develop deployable network models.
	CO4	Apply the knowledge of time synchronization and localization, improve channel utilization.
	CO5	Identify security challenges in WSN, design, develop and deploy sensors with security protocols.

Subject with code: Wireless Sensor Networks19EC8OE2

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand principles, challenges and constraint in wireless sensor networks	2	2										1	2		
CO2	Analyze network deployment with knowledge of node and network architectures	3	2										1	2	1	
CO3	Analyze and evaluate the performance of different routing and MAC protocols and develop deployable network models.	3	2			2							1	2	1	2
CO4	Apply the knowledge of time synchronization and localization, improve channel utilization.	3	2			2							1	2	1	2
CO5	Identify security challenges in WSN, design, develop and deploy sensors with security protocols.	1	2			2							1	2	2	2
	Average	2.4	2			2							1	2	1.25	2

CRYPTOGRAPHY AND NETWORK SECURITY		
Subject Code	19EC8OE3	CIE: 50
Number ofLecture Hours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course Objectives:

1. To acquire the knowledge on basic need for the information security, art of secret writing, network security services and service mechanisms, the classical encryption techniques and a popular DES algorithm.
2. To study the mathematics of public key cryptography, principles, applications and their requirements, key management and representative algorithms.
3. To study the basics of message authentication and cryptographic hash functions, digital signatures and authentication protocols.
4. To study authentication applications, services and encryption techniques.
5. To study the concepts of security measures such as E-mail, Firewalls and IP security in network based applications.

Modules-1	**Teaching Hours**
Overview: Need for information security, Services, Mechanisms and Attacks, Model for network security, Cryptography, Cryptanalysis. C**lassical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Caesar Cipher, Mono alphabetic Cipher, Play Fair Cipher, Hill Cipher. **Block Ciphers and the Data Encryption Standard (DES) Algorithm:** Traditional Block and Stream Cipher structures, Feistel Cipher, The Data Encryption Standard (DES) algorithm, Avalanche effect, Strength and Weaknesses of DES	**09 Hours**
Modules-2	
Public-Key (Asymmetric Key) Cryptography and RSA Algorithm: Mathematics of Asymmetric Key Cryptography. Principles, Applications and Requirements of Public-Key Cryptosystems, Public-key cryptanalysis. **The RSA algorithm:** Description of the algorithm, Computational aspects, and Security of RSA. **Other Public-Key Cryptosystems:** Key management, Diffie-Hellman key exchange algorithm.	**08 Hours**
Modules-3	
Message Authentication and Cryptographic Hash Functions: Authentication Requirements and Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. **Digital Signatures and Authentication Protocols:** Digital Signature Schemes and Authentication Protocols, Digital Signature Standard (DSS).	**09 Hours**
Modules-4	
Authentication Applications Entity/Message Authentication, Kerberos, Kerberos versions 4, X.509 authentication service, Kerberos Encryption techniques.	**08 Hours**
Modules-5	
Security in Network based Applications Electronic Mail Security: Pretty Good Privacy (PGP), Data Compression using ZIP. **IP Security:** Overview, IP security architecture, Authentication header, Encapsulating Security Pay Load (ESP). **Firewalls:** Design principles, Trusted systems.	**08 Hours**

Question paper pattern:

• The question paper will have ten questions.
• Each full question consists of 20marks.
• There will be 2 full questions (with a maximum of four sub questions) from each module.
• Each full question will have sub questions covering all the topics under a module. The students will have to answer 5 full questions, selecting one full question from each module.

Text books:

1. William Stallings, "Cryptography and Network Security", Prentice Hall, 2nd edition.
2. Behrouz A Forouzan and DebdeepMukhopadhyay, "Cryptography and Network Security", 3rd edition, Mc-Graw Hill Education.

Reference Books:

1. William Stallings, "Cryptography and Network Security", Pearson 6th edition.
2. V.K.Jain, "Cryptography and Network Security",Khanna Publishers.

E books and online course materials:

Course outcomes:

On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Understand and implement conventional encryption techniques.
	CO2	Implementation of public key cryptographic techniques.
	CO3	Analyze Hash functions and Digital signature schemes.
	CO4	Analyze authentication services and applications.
	CO5	Analyze the role of information and network security.

Subject with code: Cryptography and Network Security 19EC8OE3

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Understand and implement conventional encryption techniques.	3	2										1	2		
CO2	Implementation of public key cryptographic techniques.	3	2	3	3	2							1	2	2	2
CO3	Analyze Hash functions and Digital signature schemes.	3	3	3	3	2							1	2	2	2
CO4	Analyze authentication services and applications.	3	3	3	1	2							1	2	2	2
CO5	Analyze the role of information and network security.	3	3	1		2							1	2	2	
	Average	3	3	2.5	2.3	2							1	2	2	2

Seminar		
Subject Code	19ECS81	CIE: 50
Number of Lecture Hours/Week		SEE: 00
Total Number of Lecture Hours		SEE Hours: 00
CREDITS- 0:0:1:1		

Course Objectives: The student will be able to

- Explore a recent technology
- Acquire detailed knowledge of the topic
- Documentation
- Present the topic with scope for discussion

Conduct of Seminar:

- Students should present orally and interact with audience
- Students should clarify and clear all the doubts asked by the examiner

Course outcomes:
On completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
	CO1	Gain knowledge through independent learning
	CO2	Identify, understand and share knowledge of current real world issues
	CO3	Apply a multidisciplinary strategy to address current, real world issues
	CO4	Improve oral and written communication skills and explore an appreciation of the self
	CO5	Apply principles of ethics and respect him interaction with others

Seminar:19ECS81

	CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Gain knowledge through independent learning	3	2				2			3			3	3	3	
CO2	Identify, understand and share knowledge of current real world issues	3	3		2	3	3			3			3	3		
CO3	Apply a multidisciplinary strategy to address current, real world issues	3	3		2		2			3			3	3	2	
CO4	Improve oral and written communication skills and explore an appreciation of the self									3	3		3	3		
CO5	Apply principles of ethics and respect him interaction with others								3	3	3		2	3		3
	Average	3	2.66		2	3	2.33	2	3	3	3		1	3	2	3

Project Phase-II		
Subject Code	19ECP81	CIE: 50
Number of Lecture Hours/Week	06	SEE: 50
Total Number of Lecture Hours		SEE Hours: 03
CREDITS- 0:0:3:12		

Course Objectives: The student will be able to

- Design and develop individual models of the project
- Integrate the modules and test the workability
- Document the work details
- Organize and present the work

Conduct of Project Viva Voce:

- Students should write brief description about the project
- Students should present and demonstrate the project
- Students should clarify and clear all the doubts asked by the examiner

Course outcomes:
completion of the course, the student will have the ability to:

Course Code	CO #	Course Outcome (CO)
19ECP81	CO1	Implement the layout/schematic as modules
	CO2	Test the individual modules, record the results and analyze
	CO3	Integrate the modules, record the results and analyze
	CO4	Document the work and presentation.
	CO5	Demonstration of the work done (Viva Voce)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Implement the layout/schematic (Design)	3	3	2	1	3				3		3	1	2	2	
Test the individual modules, record the results and analyze	2	2			2				3			1	2	2	
Integrate the modules, record the results and analyze	2	3			2		2		3			1	2	2	
Document the work and presentation.									3	3					
Demonstration of the work done	1	1		1	2	3	3	3	3	3	3	1	2	2	2
Average	2	2.25	2	1	2	3	2.5	3	3	3	3	1	2	2	2