CURRICULUM

FOR THE YEAR 2019-23

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

III and IV SEMESTER B.E.

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING
(Autonomous Engineering college Affiliated to VTU Belagavi)
KALABURAGI-585102

About the institution

The Hyderabad Karnataka Education (HKE) society founded by Late Shri Mahadevappa Rampure, a great visionary and educationist. The HKE Society runs 46 educational institutions. Poojya Doddappa Appa 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 education and 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 the VTU.

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 III Semester B.E in Electronics and Communication Engineering

	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
Code									
19MA31C	Mathematics-III	02	02	--	04	50	50	100	3
19EC32	Field Theory	04	--	--	04	50	50	100	4
19EC33	Electronic Devices and Circuits	04	--	--	04	50	50	100	4
19EC34	Network Analysis	04	--	--	04	50	50	100	4
19EC35	Digital Electronics	03	--	--	03	50	50	100	3
19HU36	Constitution of India and Professional Ethics	02	--	--	02	50	50	100	--
19ECL31	Electronics Devices and Circuits Lab	--	--	02	02	50	50	100	1
19ECL32	Network Analysis Lab	--	--	02	02	50	50	100	1
19ECL33	Digital Electronics Lab	--	--	02	02	50	50	100	1
		21	02	06	29	500	500	1000	21

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

	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
Code									
19EC41	Transmission line and waveguide	03	--	--	03	50	50	100	3
19EC42	Signals and Systems	04	--	--	04	50	50	100	4
19EC43	Analog Electronics	04	--	--	04	50	50	100	4
19EC44	Microprocessors	04	--	--	04	50	50	100	4
19EC45	Analog Communication	04	--	--	04	50	50	100	4
19CV46	Environment Studies	02	--	--	02	50	50	100	--
19EC47	Kannada	02	--	--	02	50	50	100	1
19ECL41	Analog Electronics Lab	--	--	02	02	50	50	100	1
19ECL42	Analog Communication Lab	--	--	02	02	50	50	100	1
19ECL43	Microprocessors Lab	--	--	02	02	50	50	100	1
		21	--	06	27	450	450	900	23

FIELD THEORY		
Subject Code	19EC32	CIE: 50
Number of Lecture Hours/Week	4 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Modules-1		**Teaching Hours**
Preliminaries: Vector analysis and coordinate transformation: vector algebra, coordinate systems, vector components, unit vector, dot & cross products. Cylindrical and spherical, coordinate system, coordinate transformations. **Coulomb's law electric field intensity**: Experimental coulombs law, electric field intensity, electric field due to continuous volume charge, line charge, sheet charge. Electric flux density, Gauss law and Divergence: electric flux density, Gauss law and its applications, divergence theorem.		**11 Hours**
Modules-2		
Energy and potential: Energy and potential in a moving point charge in an electric field, line integral, potential difference and potential, potential field of a point charge, The potential field of a system of charges-conservative property, potential gradient, the dipole, energy density in electric field. **Conductors, dielectric and capacitance**: Current and current density, continuity of current, Metallic conductors, conductor properties and boundary conditions, Capacitance, several capacitance examples. Capacitance of a two-wire line		**10 Hours**
Modules-3		
Poisson's and Laplace's equation: Poisson's and Laplace's equations, Uniqueness theorem, solution of Laplace's equation, examples of solutions of Poisson's equations **Magnetic Fields:** Steady Magnetic fields: Biot savart's law, Ampere's circuital law, Curl. Stokes theorem, magnetic flux and flux density, Magnetic forces, material and inductances: Scalar and vector magnetic potentials, magnetic force between differential current elements , force and torque on a closed circuit, magnetic boundary conditions , magnetic circuit, inductance.		**10 Hours**
Modules-4		
Time varying fields and Maxwell's equations: Faraday's law, displacement current, Maxwell's equations in point form and integral form, the retarded potentials. **Uniform plane wave**: Wave propagation in free space, wave propagation in dielectrics,		**11 Hours**

the Poynting vector & power considerations, propagation in good conductors-skin effect, wave polarisation.	
Modules-5	
Plane waves at boundaries & in dispersive media: Reflection of uniform plane waves at normal incidence, standing wave ratio, wave reflection from multiple interfaces, plane wave propagation in general directions, plane wave reflection at oblique incidence angles, plane wave propagation in dispersive media.	**10 Hours**

Course objectives

1. To appreciate the theory of vector analysis
2. To understand the concepts of electrostatics, electrical potential, energy density and their applications
3. To analyze the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications
4. To explore Biot-Savart's Law, Ampere's Law, Faraday's Laws, and Maxwell's equations

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 H Hayt Jr and John A Buck., Engineering electromagnetic, TMH 7th ed.
2. E C Jordon & K G . Balmain., electromagnetic waves and radiation system., PHI 2nd ed.

Reference Books:

1. Kraus J D and Carver K R., electromagnetic., (TMH)
2. J A Edminister., electromagnetic, TMH 2nd ed.
3. P V Gupta., An Introduction Course in electromagnetic.
4. P. N . O Sadiku, "Elements of electromagnetic" 4th ed. Oxford University press.

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)
19EC32	**CO1**	Compute electric field intensity & potential using Coulomb's law & Gauss's law.
	CO2	Analysis of EM field using boundary conditions.
	CO3	Analysis of steady magnetic fields.
	CO4	Analysis of time varying fields using Maxwell's equations and wave propagation in different media.
	CO5	Analysis of wave reflection in different media.

19EC32: Field Theory

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Compute electric field intensity & potential using Coulomb's law & Gauss's law.	3	3	2					1		1		1	3	2	2
CO2	Analyze EM field using boundary conditions	3	3	2					1		1		1	3	2	2
CO3	Analyze steady magnetic fields.	3	3	2					1		1		1	3	2	2
CO4	Analyze time varying fields using Maxwell’s equations and wave propagation in different media.	3	3	2					1		1		1	3	2	2
CO5	Analyze wave reflection in different media.	3	3	2					1		1		1	3	2	2
Average		3	3	2					1		1		1	3	2	2

ELECTRONIC DEVICES AND CIRCUITS		
Subject Code	19EC33	CIE: 50
Number of Lecture Hours/Week	4 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Module-1		**Teaching Hours**
Diode characteristics: Introduction, load line analysis, diode approximations, series diode configuration with DC inputs, parallel and series, parallel configurations, **Diodes applications**: AND / OR gates, half wave rectification, full wave rectification, clippers, clampers, zener diodes as regulators and voltage multiplier circuits.		**11 Hours**
Module-2		
Bipolar Junction transistor: Introduction, transistor construction, input output characteristics, operating point, transistor amplifying actions, common emitter configurations and common collector configurations, **Transistor biasing:** operating point, fixed bias circuit, emitter stabilized bias circuits and voltage divider bias. **Small signal analysis:** BJT transistor modeling and hybrid equivalent model of small signal amplifier configuration and deriving voltage gain, input impedance and output impedance.		**11 Hours**
Module-3		
Field Effect Transistors: Construction and characteristics of JFET's, transfer characteristics, depletion type of MOSFET, enhancement type MOSFET, **FET biasing:** fixed bias configurations, self bias configurations, voltage divider biasing. **Small signal analysis:** small signal model of JFET, FET amplifier design.		**10 Hours**
Module-4		
Feedback and Oscillator circuits: Feedback concepts, feedback connection types, practical feedback circuits, feedback amplifier, phase and frequency considerations, **Oscillators:** operation, phase shift oscillator, wien bridge oscillator, tuned oscillator circuits, crystal oscillator.		**10 Hours**
Module-5		
Multilayer devices: SCR, SCR characteristics and ratings, basic controlled rectifier, DIAC, TRIAC, UJT, programmable UJT, basic operation of chopper, operation of single phase inverters.		**10 Hours**
Course objectives: After studying this course, students will be able to: 1. Design of diode circuits 2. Biasing of BJTs and FETs 3. Construction of amplifiers using BJT and FET 4. Construction of oscillators. 5. Construction of SCR, DIAC and TRIAC		

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, there will be five modules.
- 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. Robert L Boylestad, "Electronic Devices and Circuit Theory", PHI, 6th edition 1999.
2. MilimanHalkias, "Electronic Devices and circuits", TMH.

Reference Books:

1. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 6th Edition, Oxford University Press, 2010.
2. David A.Bell, "Electronic Devices and Circuits", Oxford Higher Education Press, 5thediton, 2010

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC33	**CO1**	Design and analyze diode circuits.
	CO2	Analyze transistor biasing circuits and amplifiers using small signal model.
	CO3	Analyze FET biasing circuits and amplifiers using small signal model.
	CO4	Analyze feedback amplifiers and design oscillators.
	CO5	Analyze power devices and their applications.

19EC33: Electronic devices and circuits

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Design and analyze diode circuits.	3	3	1					1		1		1	3	2	2
CO2	Analyze transistor biasing circuits andampliifiers using small signal model.	3	3	2					1		1		1	3	2	2
CO3	Analyze FET biasing circuits andampliifiers using small signal model.	3	3	2					1		1		1	3	2	2
CO4	Analyze feedback amplifiers and design oscillators.	3	3	3					1		1		1	3	2	2
CO5	Analyze power devices and their applications	3	3	2				2	1		1		1	3	2	2
Average		3	3	2				2	1		1		1	3	2	2

NETWORK ANALYSIS		
Subject Code	19EC34	CIE: 50
Number of Lecture Hours/Week	4 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS –4		
Module-1		**Teaching Hours**
Circuit analysis: Practical voltage and current sources, controlled and uncontrolled sources, source transformation, KCL and KVL analysis, nodal and mesh analysis, super node and super mesh analysis. **Graph Theory:** Topological description, topological structures, tree, tree branch and link, incidence matrix, cut set and tie set matrices.		**11 Hours**
Module-2		
Transient Analysis: Capacitive and inductive transients and equivalent circuits, transients in RL, RC and RLC circuits, initial and final conditions, time constants. steady state analysis general discussion, concepts of phasor and vector, impedances and admittance, complete sinusoidal steady state circuit solutions.		**11 Hours**
Module-3		
Network theorems: Thevenins and Norton's, Superposition, Reciprocity, Compensation, Substitution, Maximum power transfer, Millman's and Tellegen's theorems, problems with dependent and independent sources.		**10 Hours**
Module-4		
Network functions: Concepts of complex frequency, network and transfer functions for one port and two ports, significance of poles and zeros, stability analysis of networks.		**10 Hours**
Module-5		
Two port parameters: Z, Y, ABCD, hybrid parameters, their inverse and image parameters, relationship between parameters, interconnection of two port networks.		**10 Hours**

Course objectives:

1. To introduce KCL, KVL and Graph theory.
2. To introduce transient analysis.
3. To apply and analyze various network theorems in solving the problems related electrical circuits.
4. To describe and analyze Two-Port networks.
5. To describe Z,Y,A,B,C,D and hybrid parameters.

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, there will be five modules.
- 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. M. E. Van Valkanberg, “Network Analysis”, PHI
2. Hayt. W. H. & J. E. Kemmerly, “Engineering Circuit Analysis”, TMH

Reference Books:

1. William D Stanley, “Network Analysis with Applications”, Pearson Education
2. Roy Choudhary D, “Network and systems”, New age Publications

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC34	**CO1**	Apply circuit laws to reduce circuit complexity and to arrive at feasible solutions.
	CO2	Analyze RL, RC, RLC circuits under transient and sinusoidal steady state conditions.
	CO3	Apply Network theorems toanalyze AC and DC circuits.
	CO4	Compute transfer functions of circuits for analyzing stability.
	CO5	Compute Two-Port network parameters and their relationship.

19EC34: Network Analysis

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Apply circuit laws to reduce circuit complexity and to arrive at feasible solutions.	3	3	2					1		1		1	3	3	2
CO2	Analyze RL, RC, RLC circuits under transient and sinusoidal steady state conditions.	3	3	2					1		1		1	3	3	2
CO3	Apply Network theorems to analyze AC and DC circuits.	3	3	2					1		1		1	3	3	2
CO4	Compute transfer functions of circuits for analyzing stability.	3	3	2					1		1		1	3	3	2
CO5	Compute Two-Port network parameters and their relationship.	3	3	2					1		1		1	3	3	2
Average		3	3	2					1		1		1	3	3	2

DIGITAL ELECTRONICS		
Subject Code	19EC35	CIE: 50
Number of Lecture Hours/Week	4 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Module-1		**Teaching Hours**
Boolean Algebra and Minimization techniques: Boolean postulates and laws, minimization of Boolean expressions, minterm maxterm, canonical forms, Karnaugh map minimization, VEM technique, Quine-McCluskey method of minimization. **Logic Gates:** Basic gates, universal gates, exclusive–OR and exclusive–NOR, implementations of logic functions using gates, NAND–NOR implementations,multi level gate implementations, multi output gate implementations,		**11 Hours**
Module-2		
Combinational Circuits: Design procedure, half adder, full Adder, half subtractor, full subtractor, parallel binary adder and subtractor, carry look ahead adder, BCD adder, binary multiplier, binary divider, multiplexer and demultiplexer, decoder and encoder, parity checker, parity generators, code converters, magnitude comparators.		**10 Hours**
Module-3		
Sequential Circuits: Latches and flip-flops, types of flip-flops, characteristic table and equation, realization of one flip flop using other flip flops, excitation table, edge triggering, level triggering, asynchronous/ripple counter, synchronous counters, synchronous up/down counters, design of synchronous counters: state table, state diagram, state minimization, state assignment, sequence generators.		**11 Hours**
Module-4		
Synchronous Sequential Circuits: General model, classification, design of algorithmic state machine, analysis of synchronous sequential circuits. **Asynchronous Sequential Circuits:** Design of fundamental mode and pulse mode circuits, problems in asynchronous circuits, design of hazard Free Switching circuits.		**10 Hours**
Module-5		
Memory devices: Registers, shift registers, universal shift registers, classification of memories, RAM organization, ROM organization, timing waveforms for read and write operation, address decoding and memory expansion **Programmable Logic Devices**: Programmable logic array (PLA), programmable array logic (PAL), field programmable gate arrays (FPGA), implementation of combinational logic circuits using ROM, PLA, PAL		**10 Hours**

Course objectives: This course will enable students to:

- To introduce basic postulates of Boolean algebra and shows the Correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of Combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits.

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, there will be five modules.
• 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. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008
2. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

Reference Books:

1. Morris and Miller."Designing with TTL integrated circuits", McGrawHill
2. Fletcher, "An Engineering approach to digital Design", PHI
3. Kohavi, "Switching and Finite Automata Theory",TMH

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC35	**CO1**	Apply different methods for simplification of Boolean expressions and realize using gates.
	CO2	Design and realize Combinational circuits.
	CO3	Design and realize sequential circuits.
	CO4	Analyze synchronous and asynchronous sequential circuits.
	CO5	Analyze memory devices and memory organization.

19EC35: Digital Electronics

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Apply different methods for simplification of Boolean expressions and realize using gates.	3	2	3					1		1		1	3	3	2
CO2	Design and realize Combinational circuits.	3	3	3					1		1		1	3	3	2
CO3	Design and realize sequential circuits.	3	3	3					1		1		1	3	3	2
CO4	Analyze synchronous and asynchronous sequential circuits.	3	3	3					1		1		1	3	3	2
CO5	Analyze memory devices and memory organization.	1	1	2					1		1		1	3	3	2
Average		2.6	2.4	2.8					1		1		1	3	3	2

ELECTRONIC DEVICES AND CIRCUITS LABORATORY		
Subject Code	19ECL31	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS –1		

1. Fixed-bias amplifier circuit using BJT.
2. Design and construct BJT CE amplifier using voltage divider bias with and without bypassed emitter resistor.
3. Darlington amplifier
4. Differential amplifier using BJT.
5. Series and Parallel clipping circuits
6. Series and Parallel clamping circuits
7. Half-wave rectifier with/without capacitor filter.
8. Full-wave rectifier with/without capacitor filter.
9. Oscillators.
10. Design of a single stage voltage series feedback amplifier and draw frequency response.
11. Zener voltage regulator
12. Characteristics of SCR, UJT.
13. Power electronics circuits

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 ma rks.

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

Course Code	CO #	Course Outcome (CO)
19ECL31	**CO1**	Design of transistor amplifier circuits.
	CO2	Analyze and design wave shaping circuits.
	CO3	Design of DC power sources.
	CO4	Design of oscillators.
	CO5	Design of power circuits.

19ECL31: Electronic devices and circuits lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Design of transistor amplifier circuits	3	3	1			1	1	2	3	2		1	3	2	2
CO2	Analyze and design wave shaping circuits	3	3	1			1	1	2	3	2		1	3	2	2
CO3	Design of DC power sources	3	3	2			1	1	2	3	2		1	3	2	2
CO4	Design of oscillators	3	3	2			1	1	2	3	2		1	3	2	2
CO5	Design of power circuits	3	3	2			1	1	2	3	2		1	3	2	2
Average		3	3	1.6			1	1	2	3	2		1	3	2	2

NETWORK ANALYSIS LABORATORY		
Subject Code	19ECL32	CIE: 50
Number of Lecture Hours/Week	02 Hours (Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS –1		

1. Study of KCL, KVL
2. Network theorems:
   i) Thevenin and Norton
   ii) Superposition
   iii) Maximum power theorem
3. Resonance and tuned circuits
   i) Series resonance
   ii) Parallel resonance
3. Transient analysis
4. Steady state analysis
5. Measurement of impedance and admittance using two port network
6. Filters
   i) low pass
   ii) high pass

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 ma rks.

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

Course Code	CO #	Course Outcome (CO)
19ECL32	**CO1**	Verification of KCL and KVL.
	CO2	Verification of network theorems.
	CO3	Design of resonance circuits.
	CO4	Analyze transient and steady state response.
	CO5	Implementing different analog filters.

19ECL32: Network Analysis lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Verification of KCL and KVL	3	3	1			1	1	2	3	2		1	3	2	2
CO2	Verification of network theorems	3	3	1			1	1	2	3	2		1	3	2	2
CO3	Design of resonance circuits	3	3	1			1	1	2	3	2		1	3	2	2
CO4	Analyze transient and steady state response	3	3	2			1	1	2	3	2		1	3	2	2
CO5	Implementing different analog filters	3	3	1			1	1	2	3	2		1	3	2	2
Average		3	3	1.2			1	1	2	3	2		1	3	2	2

DIGITAL ELECTRONICS LAB		
Subject Code	19ECL33	CIE: 50
Number of Lecture Hours/Week	02Hours (Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS –1		

1. Design and implementation of Adder and Subtractor using logic gates.
2. Design and implementation of code converters using logic gates
3. Design and implementation of 4 bit binary Adder/ subtractor and BCD adder using IC 7483
4. Design and implementation of 2 bit Magnitude Comparator using logic gates and 8 Bit Magnitude Comparator using IC 7485
5. Design and implementation of 16 bit odd/even parity checker generator using IC74180.
6. Design and implementation of Multiplexer and De-multiplexer using logic gates and realization Boolean functions using MSI MUX/DEMUX
7. Design and implementation of encoder and decoder using logic gates and realization Boolean functions using MSI Encoders/Decoder.
8. Design and realization of 2-bit, 3-bit and 4-bit ripple counters.
9. Design and implementation of synchronous counters.
10. Implementation of SISO, SIPO, PISO and PIPO shift registers using flip-flops.
11. Realization of ring counters using 7495.

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.
  5. Change of experiment is allowed only once and will be evaluated for 85% of the total marks.

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

Course Code:	CO #	Course Outcome (CO)
19ECL33	**CO1**	Simplification of Boolean expressions and realization using gates.
	CO2	Design and realize combinational circuits using MSI ICs.
	CO3	Design and realize asynchronous counters.
	CO4	Design and realize synchronous counters.
	CO5	Design and realize sequential circuits using shift registers.

19ECL33: Digital Electronics Lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Simplification of Boolean expressions and realization using gates.	2	2	1			1	1	2	3	2		1	3	2	2
CO2	Design and realize combinational circuits using MSI ICs	3	3	1			1	1	2	3	2		1	3	2	2
CO3	Design and realize asynchronous counters.	3	3	1			1	1	2	3	2		1	3	2	2
CO4	Design and realize synchronous counters	3	3	1			1	1	2	3	2		1	3	2	2
CO5	Design and realize sequential circuits using shift registers.	3	3	1			1	1	2	3	2		1	3	2	2
	Average	2.8	2.8	1			1	1	2	3	2		1	3	2	2

IV SEMESTER

TRANSMISSION LINES AND WAVE GUIDES			
Subject Code	**19EC41**	CIE	50
Number ofLecture Hours/Week	03 Hours	SEE	50
Total Number ofLecture Hours	42	SEE Hours	03
CREDITS –3:0:0:0			

Course objectives: This course will enable students to:

- To study the transmission line parameters.
- To study fundamentals concepts of transmission lines at higher frequency.
- To expose the learners to waveguide their types & modes of transmission.

Modules	Teaching Hours
Module -1	
Transmission line parameters: Line parameters**,** inductance of a line of two parallel line conductors, inductance of the coaxial line, skin effect, capacitance of two parallel line conductors, capacitance of coaxial line. A line of cascaded T sections, The transmission line –general solution, Physical significance of the equations, the infinite line, Wavelength, velocity of propagation, Waveform distortion.	**08 Hours**
Module -2	
Low and high frequency Transmission line: The distortion less line, Reflection on a line not terminated in Zo, Reflection coefficient, Open & short-circuited lines, Reflection factor & reflection loss, Insertion loss, Constants for the line of zero dissipation, Voltages &currents on the Dissipation less line, Standing waves, nodes, standing-wave ratio, Input Impedance of the dissipation less line, Input impedance of open &short circuited lines, constants for the line with small dissipation, OC and SC impedances	**09 Hours**
Module -3	
Impedance matching in high frequency lines: The quarter-wave line, impedance matching, the half-wave line, the exponential line for impedance transformation, Single & double stub impedance matching on a line, Smith chart & its applications.	**08 Hours**
Module -4	
Guided waves between parallel planes: Application of the restriction to Maxwell's equations, Types of propagation: TM, TE &TEM waves, Transmission of TM Waves between parallel planes, Transmission of TE waves between parallel planes, Transmission of TEM waves between parallel planes.	**08 Hours**
Module -5	
WAVE GUIDES: Application of Maxwell's equations to the rectangular wave guide, The TEm,n and TMm,n wave in the rectangular guide, cylindrical wave guides, The TEM wave in the coaxial line, Cavity resonator	**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 will have to answer 5 full questions, selecting one full question from each module.

Reference Books:
1. J.D. Ryder, Network lines & fields, PHI
2. Jordan. E.C and Balmain., Electromagnetic waves and radiating systems, PHI.
3. Sanjeev Gupta., Microwave Engineering.

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

Course Code:	**CO #**	**Course Outcome (CO)**
19EC41	**CO1**	Determine the Line parameters.
	CO2	Determine the propagation characteristics of transmission lines under different conditions.
	CO3	Analyze different impedance matching methods.
	CO4	Analyze propagation characteristics of electromagnetic waves in parallel planes.
	CO5	Analyze the behavior of different modes of propagation in various wave guides.

19EC41: Transmission lines and waveguides

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Determine the Line parameters.	3	3	2	1				1		1		1	3	3	2
CO2	Determine the propagation characteristics of transmission lines under different conditions.	3	3	2	2				1		1		1	3	3	2
CO3	Analyze different impedance matching methods.	3	3	3	2				1		1		1	3	3	2
CO4	Analyze propagation characteristics of electromagnetic waves in parallel planes	3	3	2	2				1		1		1	3	3	2
CO5	Analyze the behavior of different modes of propagation in various wave guides.	3	3	3	2				1		1		1	3	3	3
		3	3	2.4	1.8				1		1		1	3	3	2.8

SIGNALS AND SYSTEMS		
Subject Code	19EC42	CIE: 50
Number of Lecture Hours/Week	4 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Module-1		**Teaching Hours**
Continuous-Time and Discrete-Time Signals: Classification of signals – even and odd, periodic and non-periodic, energy and power signals, deterministic and random signals, basic operations on signals, elementary signals, singularity functions, interconnection of systems and system properties,		**10 Hours**
Module-2		
Linear Time-Invariant Systems: Discrete-time LTI systems, the convolution sum, continuous-time LTI systems, convolution integral, properties of LTI systems, causal LTI systems described by differential and difference equations, block diagram representation of systems.		**11 Hours**
Module-3		
Signal Analysis and Fourier representation of Continuous-Time signals: Analogy between vectors and signals, approximation of a function by set of mutually orthogonal functions, trigonometric Fourier series, exponential Fourier series, properties of Fourier series, The continuous-time Fourier transform, Fourier transform of periodic signals, properties of Fourier transforms.		**10 Hours**
Module-4		
Fourier representation of Discrete-Time signals: Sampling theorem, recovery of signal from its samples, discrete-time Fourier series (DTFS), properties of DTFS, discrete-time Fourier transform (DTFT), properties of DTFT, applications of continuous-time Fourier transform and discrete-Time Fourier transform.		**11 Hours**
Module-5		
Z-Transform: The Z-Transform, region of convergence (ROC) and its properties, inverse Z-transform, geometric evaluation of the Fourier transform from the pole-zero plot, properties of Z-transform, analysis and characterization of LTI systems using Z-Transforms, unilateral Z-transform.		**10 Hours**
Course objectives: After studying this course, students will be able to: • To understand basics of signals and systems, sampling theorem. • To learn Linear Time Invariant systems and properties of LTI systems. • To understand Fourier representation of Continuous Time signals. • To understand Fourier representation of Discrete Time signals. • To learn Transform and its applications.		
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, there will be five modules.
• 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. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson Education, 2007.
2. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005

Reference Books:

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001
2. Miichael J Roberts, Govind Sharma, "Fundamentals of Signals and Systems", 2nd Edition, McGrawHill 2010

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC42	**CO1**	Analyze different signals and operations on signals.
	CO2	Analyze LTI systems and determine properties of LTI systems.
	CO3	Analyze Continuous-Time signals in Fourier Domain.
	CO4	Analyze Discrete-Time signals in Fourier domain.
	CO5	Analyze Discrete-Time signals using Z-Transform.

19EC42: Signals and Systems

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze different signals and operations on signals	3	3		2				1		1		1	3	3	2
CO2	Analyze LTI systems and determine properties of LTI systems	3	3		2				1		1		1	3	3	2
CO3	Analyze Continuous-Time signals in Fourier Domain.	3	3		2	2			1		1		1	3	3	2
CO4	Analyze Discrete-Time signals in Fourier domain.	3	3		2	2			1		1		1	3	3	2
CO5	Analyze Discrete-Time signals using Z-Transform.	3	3		2	2			1		1		1	3	3	2
		3	3		2	2			1		1		1	3	3	2

ANALOG ELECTRONICS		
Subject Code	19EC43	CIE: 50
Number of Lecture Hours/Week	4 (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Module-1		**Teaching Hours**
Op-amp Basics: Analysis of differential amplifier. common mode and differential mode gains, transfer characteristics, CMRR, I/P & O/P impedances, ideal op-amp characteristics, cascading of differential amplifier, I/P ,O/P stages and level translators. **Linear operational amplifier Applications**: Inverting, non–inverting, differential bridge amplifiers, summer, integrator, differentiator, V to I & I to V converters, op–amp feedback limiters using diodes, log and antilog amplifiers, analog multipliers, dividers, sample and hold circuits, peak detectors, precision rectifiers, instrumentation amplifier.		**11 Hours**
Module-2		
Non linear operational amplifier Applications: Monostable and astable multivibrators, comparators, Schmitt trigger using operational-amplifier. **Waveform generation:** Signal generators, triangular/rectangular, wave generator, phase shift oscillator **Timers:** Basic timer circuit, 555 timer used as monostable and astable multivibrators, timer others applications.		**10 Hours**
Module-3		
Data converters: Performance parameters, D/A converters, weighted binary type, ladder R–2R converters, **A/D converters:** Performance parameters, types of ADC, V/t, V/f counter ramp, continuous ramp, flash type ADC, successive approximation type converter.		**10 Hours**
Module-4		
PLL: Basic principles, phase detector/comparator, VCO, low pass filter, monolithic phase locked loop **PLL applications:** Frequency multiplication/division, frequency translation, AM detection, FM detection		**11 Hours**
Module-5		
DC voltage regulators: Analysis and design of series and shunt regulators using op-amp, some commercial voltage regulators, fixed and variable, current boosting **Switching regulators**: Basic concepts and its applications.		**10 Hours**
Course objectives: After studying this course, students will be able to: 1. Design op-amp circuits 2. Understand generation of various waveforms 3. Understand working and operation of data converters 4. Working of regulators and its applications		

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, there will be five modules.
- 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. D Roy Choudhary, "Linear Integrated Circuits", New Age Publications 5th edition 2018.
2. Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI, 4th edition, 2014

Reference Books:

1. David A.Bell, "Operational Amplifiers and Linear ICs", PHI, 2nd edition, 2009.

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC43	**CO1**	Analyze Op-amp circuits and their applications.
	CO2	Design of waveform generators using Op-amp and timers.
	CO3	Determine performance parameters of data converters.
	CO4	Analyze PLL operation and its applications.
	CO5	Design of voltage regulators.

19EC43: Analog Electronics

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze Op-amp circuits and their applications	3	3	3	2				1		1		1	3	2	2
CO2	Design of waveform generators using Op-amp and timers	3	3	3	2				1		1		1	3	2	2
CO3	Determine performance parameters of data converters	3	3	2	2				1		1		1	3	2	2
CO4	Analyze PLL operation and its applications	3	3	2	2				1		1		1	3	2	2
CO5	Design of voltage regulators	3	3	2	2				1		1		1	3	2	2
	Average	3	3	2.4	2				1		1		1	3	2	2

MICROPROCESSORS AND INTERFACES		
Subject Code	19EC44	CIE: 50
Number of Lecture Hours/Week	4 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4		
Module-1		**Teaching Hours**
INTRODUCTION TO MICRO PROCESSORS: Historical background, general microcomputer and microprocessor operation, Harvard vs Von-Neuman architecture, RISC and CISC machines, pipelining. Intel's 8086 CPU architecture, pin configuration, memory segmentation, physical and logical address generation and examples.		**10 Hours**
Module-2		
INSTRUCTION SET OF 8086: Addressing Modes of 8086,delay calculation using T-states, assembler instruction format, data transfer, arithmetic, branch type, logical, shift and rotate instructions, string instructions, machine control and flag manipulation instructions. Illustration of these instructions with example programs.		**11 Hours**
Module-3		
DIRECTIVES AND OPERATORS: Introduction to assembler directives and DOS functions, programming examples involving assembler directives, DOS Functions for read keyboard, display (01, 08, 06, 02, 09,0A) **MODULAR PROGRAMMING:** concepts of macros (near and far) and procedures (near and far), programming examples. **8086 INTERRUPTS:** 8086 Interrupts and interrupt responses.		**11 Hours**
Module-4		
8086 BASED MULTIPROCESSING SYSTEMS: Coprocessor configurations, 8087 numeric data processor, data types, processor architecture, instruction set and examples. **SYSTEM BUS STRUCTURE:** Basic 8086 configurations: minimum mode, maximum mode. Memory interfacing to 8086, design examples.		**10 Hours**
Module-5		
BASIC I/O INTERFACES AND APPLICATIONS: Study of 8255 PPI, 8253 timer, 8251 USRAT and programming, interfacing microprocessor to keyboard, stepper motor , ADC, DAC, LED. a brief comparative study of important features of80386, 80486 and Pentium microprocessors.		**10 Hours**
Course Objectives o To introduce 8086 Microprocessor architecture, Pin configuration and memory segmentation. o To describe instruction set of 8086.		

- To introduce directives, DOS functions and Modular programming.
- To introduce the Multi-processing using 8086.
- To introduce interfacing of 8255 PPI, 8253 Timer and 8251 USART to 8086.

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, there will be five modules.
• 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. Douglas V Hall**, "**MICROPROCESSOR AND INTERFACING- PROGRAMMING & HARDWARE", 2nd edition , TMH, 2006.

Reference Books:

1. Y.C. Liu and G. A. Gibson,"MICROCOMPUTER SYSTEMS-THE 8086 / 8088 FAMILY**"**, 2nd edition, PHI-2003
2. Barry B. Brey **, "**THE INTEL MICROPROCESSOR, ARCHITECTURE, PROGRAMMING AND INTERFACING", 6TH EDITION, Pearson Education / PHI, 2003

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC44	**CO1**	Study the architecture and basic concepts of 8086.
	CO2	Write assembly language programs.
	CO3	Use DOS functions and Directives in ALP.
	CO4	Study and interface coprocessor and memory devices.
	CO5	Interface different peripheral devices to 8086.

19EC44: Microprocessors and Interfaces

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Study the architecture and basic concepts of 8086	3	3	2					1		1		1	3	3	3
CO2	Write assembly language programs	3	3	2	2				1		1		1	3	3	3
CO3	Use DOS functions and Directives in ALP	3	3	2	2				1		1		1	3	3	3
CO4	Study and interface coprocessor and memory devices.	3	3	2	3				1		1		1	3	3	3
CO5	Interface different peripheral devices to 8086	3	3	2	3				1		1		1	3	3	3
	Average	3	3	2	2				1		1		1	3	3	3

ANALOG COMMUNICATION		
Subject Code	19EC45	CIE: 50
Number of Lecture Hours/Week	4 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
Credits-4		
Module-1		**Teaching Hours**
Random Signals and Noise: Probability and random variables, expectation, transformation of random variables, Gaussian random variables, the central limit theorem, random processes, correlation of Random Processes, Spectra of random signals, Gaussian processes, white noise, narrow band noise		**11 Hours**
Module-2		
Amplitude Modulation: Amplitude modulation, double sideband, double sideband suppressed carrier modulation, SSB modulation, vestigial sideband modulation, costas receiver, quardrature-amplitude modulation,		**10 Hours**
Module-3		
Angle Modulation: Basic definitions, properties of angle-modulated waves, relationship between PM and FM waves, narrow-band frequency modulation, wide-band Frequency Modulation, transmission bandwidth of FM waves, generation of FM waves, demodulation of FM signals, effect of noise in FM.		**11 Hours**
Module-4		
System and Noise Calculation: Electrical noise, noise figure, equivalent noise temperature, cascade connection of two port network, free space link calculations. **Noise in Analog Communications:** Noise in communication systems, signal to noise ratio, band-pass receiver structures, noise in linear receivers using coherent detection, noise in AM receivers using envelope detection, noise in SSB receivers, detection of frequency modulation.		**10 Hours**
Module-5		
Radio Receivers: Tuned radio frequency receiver, super heterodyne receiver- RF section, frequency mixers, tracking, intermediate frequency, AGC. Receiver parameters & characteristics, FM receiver and its comparison with AM receiver. **Pulse modulation**: Types of pulse modulation, PAM generation (Single polarity, double polarity) and demodulation. PWM generation & demodulation, PPM generation and demodulation.		**10 Hours**
Course objectives: • To introduce the concepts of analogue communication systems • To equip students with various issues related to analogue communication such as modulation, demodulation		

- To understand effect of noise on the performance of communication system To understand basics of noise calculation

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, there will be five modules.
• 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. Simon Haykin, 'Introduction to Analog and Digital Communications', Second Edition.
2. Herbert Taub, Donald L.Schiling' Principles of communication systems, Second Edition

Reference Books:

1. Bruce Carlson, 'Communication Systems', McGraw Hill
2. Ziemmer, 'Principles of Communication', Wiley India, Ed., 2009
3. Dennis Roddy and John Coolen, 'Electronic Communication Systems' PHI.

E books and online course materials: NPTEL

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

Course Code	CO #	Course Outcome (CO)
19EC45	**CO1**	Analyze random variables and random process.
	CO2	Analyze different amplitude modulation and demodulation techniques.
	CO3	Analyze different angle modulation and demodulation techniques.
	CO4	Analyze Noise in Analog communication systems.
	CO5	Analyze the working of Radio receivers, pulse modulation and demodulation techniques.

19EC45: Analog Communication

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze random variables and random process	3	2	2	2				1		1		1	3	2	2
CO2	Analyze different amplitude modulation and demodulation techniques	3	3	2	2				1		1		1	3	2	2
CO3	Analyze different angle modulation and demodulation techniques	3	3	2	2				1		1		1	3	2	2
CO4	Analyze Noise in Analog communication systems	3	3	2	2				1		1		1	3	2	2
CO5	Analyze the working of Radio receivers, pulse modulation and demodulation techniques	3	2	2	2				1		1		1	3	2	2
		3	2.6	2	2				1		1		1	3	2	2

ANALOG ELECTRONICS LABORATORY		
Subject Code	19ECL41	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS –1		

1. Linear applications of Op-amp
   i) Inverting and Non inverting amplifier
   ii) Adder/Subtractor
   iii) Differentiator
   iv) Integrator
2. Non linear application of Op-amp
   i) Comparator
   ii) Schmidt trigger
   iii) Monostable and Astable operation
3. Monstable operation using 555 timer
4. Astable operation using 555 timer
5. DAC
6. ADC
7. PLL applications
8. Voltage regulators

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 ma rks.

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

Course Code:	CO #	Course Outcome (CO)
19ECL41	CO1	Implementation of linear applications of op-amp.
	CO2	Implementation of non-linear applications of op-amp.
	CO3	Implementation of 555 timer application.
	CO4	Implementation of data converters.
	CO5	Design of voltage regulators.

19ECL41: Analog Electronics lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Implement linear applications of op-amp	3	2	2		1	1	1	2	3	2		1	3	2	2
CO2	Implement non-linear applications of op-amp	3	2	2		1	1	1	2	3	2		1	3	2	2
CO3	Implement 555 timer application	3	2	2		1	1	1	2	3	2		1	3	2	2
CO4	Implement data converters	3	2	2		1	1	1	2	3	2		1	3	2	2
CO5	Design of voltage regulators	3	2	2		1	1	1	2	3	2		1	3	2	2
		3	2	2		1	1	1	2	3	2		1	3	2	2

ANALOG COMMUNICATION LAB		
Subject Code	19ECL42	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03

CREDITS- 1

1. Amplitude modulation and demodulation using envelop detector
2. Balanced modulation and SSB generation.
3. Frequency modulation and Demodulation using PLL
4. Pre-emphasis and De-emphasis circuits.
5. Automatic Gain Control in AM
6. PAM modulation and Demodulation
7. PPM Modulation and Demodulation
8. PWM Modulation and Demodulation
9. Analog Mixer Circuit.
10. Second order active high/low pass filters.
11. Second order active band pass and band stop filters.

Course objectives:

After studying this course, students will be able to:

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 ma rks.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
19ECL42	**CO1**	Implementation of various second order active filters.
	CO2	Implementation of AM and demodulation.
	CO3	Implementation of FM and demodulation.
	CO4	Implementation of pre-emphasis and de-emphasis.
	CO5	Implementation of pulse modulation techniques.

19ECL42: Analog Communication lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Implement various second order active filters	3	2	2		1	1	1	2	3	2		1	3	2	2
CO2	Implement AM and demodulation	3	2	2		1	1	1	2	3	2		1	3	2	2
CO3	Implement FM and demodulation	3	2	2		1	1	1	2	3	2		1	3	2	2
CO4	Implement pre-emphasis and de-emphasis	3	2	2		1	1	1	2	3	2		1	3	2	2
CO5	Implement pulse modulation techniques	3	2	2		1	1	1	2	3	2		1	3	2	2
		3	2	2		1	1	1	2	3	2		1	3	2	2

MICROPROCESSOR AND INTERFACES LAB		
Subject Code	19ECL43	CIE: 50
Number of Lecture Hours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS- 1		

8086 BASED PROGRAMMING

1. Data transfer instructions:

i. Byte and word data transfer in different Addressing Modes.

ii. Block move (with and without overlap).

iii. Block interchange.

2. Arithmetic & logical operations:

i. Addition and Subtraction of n- bit numbers.

ii. Multiplication and Division of signed and unsigned Hexadecimal nos.

iii. ASCII adjustment instructions

iv. Code conversions

v. Arithmetic programs to find square cube, LCM, GCD, factorial.

3. Bit manipulation instructions:

i. Whether given data is positive or negative

ii. Whether given data is odd or even

iii. Counting Logical 1's and 0's in a given data

iv. 2 out of 5 codes

v. Bit wise and nibble wise palindrome.

4. Branch/Loop instructions:

i. Arrays: addition/subtraction of 'N' no's.

ii. Finding largest and smallest nos.

iii. Arranging numbers in Ascending / descending order

ii. Near and Far Conditional and Unconditional jumps, Calls and Returns.

5. Programs on String manipulation: string transfer, string reversing, searching for a string.

6. Programs involving Software interrupts

Programs to use DOS interrupt INT 21h Function calls for

Reading a Character from keyboard, Buffered Keyboard input,

Display of character/ String on console

7. EXPERIMENTS ON INTERFACING 8086

i. Matrix keyboard interfacing

ii. Seven segment display interface

iii. Logical controller interface

iv. Stepper motor interface

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 ma rks.

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
19ECL43	**CO1**	Program 8086 for data transfer.
	CO2	Program 8086 for arithmetic and logic control application.
	CO3	Program 8086 for bit and string operations.
	CO4	Program 8086 using DOS functions.
	CO5	Program to interface 8086 with external peripheral devices.

icroprocessors and interfaces lab

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	
ram 8086 for data transfer	3	3	3	2	2	1	1	2	3	2		1	3	
ram 8086 for arithmetic and control application	3	3	3	2	2	1	1	2	3	2		1	3	
ram 8086, implementing upts	3	3	3	2	2	1	1	2	3	2		1	3	
ram timer applications	3	3	3	2	2	1	1	2	3	2		1	3	
face 8086 with external heral devices	3	3	3	3	2	1	1	2	3	2		1	3	
	3	3	3	2.8	2	1	1	2	3	2		1	3	

CURRICULUM

FOR THE YEAR 2019-23

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

V and VI SEMESTER B.E.

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING
(Autonomous Engineering college Affiliated to VTU Belagavi)
KALABURAGI-585102

About the institution

The Hyderabad Karnataka Education (HKE) society founded by Late ShriMahadevappa Rampure, a great visionary and educationist. The HKE Society runs 46 educational institutions. Poojya Doddappa Appa 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 education and 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 the VTU.

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 V Semester B.E in Electronics and Communication Engineering

	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
Code									
19EC51	Linear Control Systems	03	02	--	05	50	50	100	4
19EC52	Digital Signal Processing	04	--	--	04	50	50	100	4
19EC53	Information Theory and Coding	04	--	--	04	50	50	100	4
19EC54	Digital Communication	04	--	--	04	50	50	100	4
19EC55	Embedded Microcontrollers	03	--	--	03	50	50	100	3
18HU01	Recruitment Process Training-1	02	--	--	02	50	50	100	1
19ECL51	Digital Signal Processing Lab	--	--	02	02	50	50	100	1
19ECL52	Digital Communication Lab	--	--	02	02	50	50	100	1
19ECL53	Embedded Microcontrollers Lab	--	--	02	02	50	50	100	1
		20	02	06	28	450	450	900	23

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

	Course	Hours / Week				Maximum Marks			
		Lecture	Tutorial	Practical	Duration	CIE	SEE	Total Marks	Credits
Code									
19EC61	Entrepreneurship Management and Accounting	03	--	--	03	50	50	100	3
19EC62	Antenna and Wave Propagation	04	--	--	04	50	50	100	4
19EC63	Digital design using Verilog HDL	03	--	--	03	50	50	100	3
19EC64	Data Structures using C++	03	--	--	03	50	50	100	3
19EC65x	Elective-1	03	--		03	50	50	100	3
19HU02	Recruitment Process Training-2	02	--	--	02	50	50	100	1
19ECL61	Digital design using Verilog HDL Lab	--	--	02	02	50	50	100	1
19ECL62	Data Structures using C++ Lab	--	--	02	02	50	50	100	1
19ECL63	Mini-project	--	--	02	02	50	50	100	1
		18	--	06	24	450	450	900	20

LINEAR CONTROL SYSTEMS			
Subject Code	19EC51	CIE	50
Number of Lecture Hours/Week	3+2Hours (Theory)	SEE	50
Total Number ofLecture Hours	52	SEE Hours	03
CREDITS –3:2:0:4			

Modules	Teaching Hours
Module -1	
Basic concepts: Open-loop and Closed-loop control systems. **Mathematical Models of Physical Systems:** Differential equations of physical systems, transfer functions, Block diagram algebra, Signal flow graphs.	**10 Hours**
Module -2	
Time Response Analysis: Standard test signals, Time response of first and second order systems, Effect of adding a zero to a system, Time response specifications, Steady state errors and error constants. Performance indices.	**10 Hours**
Module -3	
Concept of stability and algebraic criteria: The concept of stability, Necessary conditions for stabililty, Hurwitz and Routh stability criterions, Relative stability analysis. **The Root Locus Technique:** The Root Locus concept, Construction of Root Loci.	**11 Hours**
Module -4	
Frequency response analysis: Correlation between time and frequency response, Bode plots – General procedure for constructing Bode plots, All pass and minimum phase systems.Polar plots, Stability in frequency domain – Nyquist stability criteria, Assessment of relative stability using Nyquist criteria.	**11 Hours**
Module -5	
State Variable Analysis and Design: Concept of state, state variables and state models, State model for Linear continuous time systems, State variables and linear discrete-time systems, Diagonalization, Solution of state equations, Controllability and Observability.	**10 Hours**

Course objectives: This course will enable students to:

- To teach the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

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. I J Nagrath and M Gopal, Control systems and Engineering, New Age Publishers 6th Edition-2017.
2. K Ogata, Modern Control Engineering, PHI 3rd Edition-2001.

Reference Books:

1. Kuo B C, Control Engineering.

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

Course Code	CO #	Course Outcome (CO)
19EC51	**CO1**	Analyze physical systems using differential equations, block diagrams and signal flow graphs.
	CO2	Analyze time response of first and second order systems.
	CO3	Construct the root locus and analyze the stability of the system in time domain.
	CO4	Construct Bode plot, Polar plot and analyze the stability in the frequency domain.
	CO5	Obtain state models for linear systems and determine for observability and controllability.

19EC51: Linear Control Systems

		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	Analyze physical systems using differential equations, block diagrams and signal flow graphs.	3	3	2					1		1		1	3	2	2
CO2	Analyze time response of first and second order systems.	3	3	2					1		1		1	3	2	2
CO3	Construct the root locus and analyze the stability of the system in time domain.	3	3	2		2			1		1		1	3	2	2
CO4	Construct Bode plot, Polar plot and analyze the stability in the frequency domain.	3	3	2		2			1		1		1	3	2	2
CO5	Obtain state models for linear systems and detrermine for observability and controllability	3	3	2					1		1		1	3	2	3
		3	3	2		2			1		1		1	3	2	2.2

DIGITAL SIGNAL PROCESSING			
Subject Code	19EC52	CIE	50
Number of Lecture Hours/Week	04 Hours	SEE	50
Total Number ofLecture Hours	52	SEE Hours	03
CREDITS –4:0:0:4			

Course objectives:

Modules	Teaching Hours
Module -1	
Discrete Fourier Transform: Representation of periodic sequences – The Discrete Fourier Series, Properties of DFS (No derivation), Sampling the Z-transform, Fourier Representation of finite duration sequences – The Discrete Fourier Transform, Properties of DFT, Examples on DFT properties.	**11 Hours**
Module -2	
DFT Continued: Linear filtering using DFT, Filtering of long data sequences, and Frequency analysis of signals using DFT. **Computation of the Discrete Fourier Transform:** Goertzel algorithm, Decimation in Time algorithms, Decimation in Frequency algorithms, FFT algorithms for N a composite number. Chirp Z-Transform algorithm.	**10 Hours**
Module -3	
FIR Filters: Properties of FIR digital filters, Design of Linear phase FIR filters using windows and frequency sampling method, Design of FIR differentiators, Design of Hilbert Transformers.	**10 Hours**
Module -4	
IIR Filters: Design of IIR digital filters from Analog filters – Impulse Invariance, Design based on numerical solution of the differential equation, Bilinear transformation, Characteristics of commonly used Analog filters, Design examples – Analog to digital Transformation. Frequency transformations. Comparison of Digital IIR and FIR filters	**11 Hours**
Module -5	
Digital Filter Structures: Basic Network structures for IIR filters – Direct forms, Cascade form, Parallel form, transposed form, Lattice structures, Basic network structures for FIR Systems – Direct forms Cascade form, Networks for Linear phase FIR systems, Frequency sampling structure, Lattice structure.	**10 Hours**

Course objectives: This course will enable students to:

- To study the basic concepts of digital signal processing.

- To study analysis and processing of signals for different kind of applications and retrieval of information from signals.
- To study designing of digital filters and its realization.
- To study analysis of signals using the discrete Fourier transform (DFT) and Z-Transform.

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.

Reference Books:

1. A.V.Oppenheim and R.W.Schafer, Digital Signal Processing, PHI.
2.J.G.Proakis and D.G.Manolakis, Digital Signal Processing- Principals, Algorithms and Applications, PHI.
3. Rabiner and Gold, Theory and Applications of Digital Signal Processing, PHI
4. SanjitK.Mitra, Digital Signal- A computer- Based Approach, TMH.

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

Course Code	CO #	Course Outcome (CO)
18EC52	**CO1**	Compute the Discrete Fourier Transform (DFT) of a sequence.
	CO2	Analyze the efficient computation of DFT using Fast Fourier Transform.
	CO3	Design FIR filters using Windows and frequency sampling Technique.
	CO4	Design digital IIR filters from Analog filters.
	CO5	Realize digital filters using network structures.

19EC52: Digital Signal Processing

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Compute the Discrete Fourier Transform (DFT) of a sequence.	3	2	2	2	2			1		1		1	3	3	2
CO2	Analyze the efficient computation of DFT using Fast Fourier Transform.	3	2	2	2	2			1		1		1	3	3	2
CO3	Design FIR filters using Windows and frequency sampling Technique.	3	2	3	2	2			1		1		1	3	3	2
CO4	Design digital IIR filters from Analog filters	3	2	3	2	2			1		1		1	3	3	2
CO5	Realize digital filters using network structures.	3	2	2	2	2			1		1		1	3	3	2
		3	2	2.4	2.4	2			1		1		1	3	3	2

INFORMATION THEORY AND CODING			
Subject Code	19EC53	CIE	50
Number of Lecture Hours/Week	4Hours (Theory)	SEE	50
Total Number of Lecture Hours	52	SEE Hours	03
CREDITS –4:0:0:4			

Modules	Teaching Hours
Module -1	
Source Coding: Introduction to information theory, information measure, entropy, Discrete memoryless source, Source information rate and source coding theorem, Huffman coding and its extension, Entropy and information rate of Markoff sources, Shannon's algorithm for source encoding.	**10 Hours**
Module -2	
Channel Capacity and Coding: Channel models, Channel capacity, Channel coding, Information capacity Theorem, The Shannon's limit, Mutual Information and their properties, estimation of channel capacity using Muroga's method,	**11 Hours**
Module -3	
Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of Block Codes, Error Detecting and Error Correcting Capabilities of Block Codes, Standard Array and Syndrome Decoding, Single Parity Check Codes, Hamming Codes, A class of single-error correcting and double-error detecting codes, Reed-Muller Code	**11 Hours**
Module -4	
Cyclic codes: Description of Cyclic codes, generator and parity Check Matrices of Cyclic codes, Encoding of cyclic codes, Syndrome computation and Error Detection, Decoding of Cyclic Codes, Bose-Chaudhuri Hocquenghem code.	**10 Hours**
Module -5	
Convolution codes: Encoding of convolution codes, Time and frequency transform domain methods, Matrix description, Graphical approaches, State transition table, State diagram, Code tree, Trellis diagram, Viterbi decoding.	**10 Hours**

Course objectives: This course will enable students to:

- To introduce the basic concepts of information theory.
- To calculate channel capacity for discrete channels.
- The course will consider the error control coding strategies.
- The course will consider different coding techniques.
- The course will introduce decoding methods for convolution codes.

Graduate Attributes (as per NBA):

• Engineering Knowledge.
• Problem Analysis.
• Design / development of solutions (partly).
• Interpretation of data.

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 Book

1. Shu Lin, Daniel J. Costello, Jr, Error Control Coding Fundamentals and Applications, 2nd Edition, Pearson, 2011.
2. Information Theory Coding and Cryptography, Ranjan Bose, Tata Mc Graw-Hill, 2008.

Reference Books:

1. K. Sam Shanmugam, Digital and Analog Communication systems, John wiley, 2006.
2. Simon Haykin, Digital Communications, Johan Wiley, 2006.
3. A. Bruce Carlson, Paul B. Crilly, Jannet C. Rutledge, Communication Systems, Fourth Edition, Mc Graw-Hill International edition, 2002

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

Course Code	CO #	Course Outcome (CO)
18EC52	**CO1**	Understand basic notion of information theory.
	CO2	Determine channel capacity.
	CO3	Analyze error control strategies.
	CO4	Analyze various coding techniques.
	CO5	Analyze decoding techniques.

19EC53: Information Theory and Coding

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand basic notion of information theory.	3	2										1	3		
CO2	Determine channel capacity.	3	2										1	3		
CO3	Analyze error control strategies.	3	3	3		2							1	3	2	2
CO4	Analyze various coding techniques.	3	3	3		2							1	3	2	2
CO5	Analyze decoding techniques.	3	3	3		2							1	3	2	2

Digital Communication			
Subject Code	19EC54	CIE	50
Number of Lecture Hours/Week	4 Hours (Theory)	SEE	50
Total Number ofLecture Hours	52	SEE Hours	03
CREDITS –4:0:0:4			

Modules	Teaching Hours
Module -1	
Pulse Modulation systems: Pulse amplitude modulation (PAM), Pulse width modulation(PWM) and Pulse position modulation(PPM). Bandwidth requirements, generation and reconstruction methods, Analog to digital conversion, quantization and encoding techniques, application to pulse code modulation (PCM), quantization noise in PCM, Companding in PCM systems, Time division multiplexing (TDM), examples of PAM and PCM systems. The T1 PCM system in telephony.	**11 Hours**
Module -2	
The delta modulator and its operation, quantization noise and slope overload in delta modulators. Comparison of delta modulation and PCM, Introduction to linear prediction theory with applications in delta modulation **Base band digital data transmission:** Base band digital communication systems, multilevel coding using PAM, pulse shaping and band width consideration, inter symbol interference (ISI). Nyquist condition for zero ISI, band-limited Nyquist pulses, the eye diagram. Duobinary and modified duo binary encoding,	**10 Hours**
Module-3	
Digital Modulation: PSK, DPSK and FSK. M-array data communication systems, quadrature amplitude modulation (QAM) systems, four phase PSK effects of noise in modulated digital communication Systems, optimum binary systems. Probability of error expression for binary Communications, probability of error in QAM systems, comparison of digital Modulation systems.	**10 Hours**
Module -4	
Spread Spectrum Systems: PN sequence, PN sequence generation, Properties of PN sequence, Gold code generation, Auto correlation and cross correlation of PN and Gold codes, Direct sequence Spread spectrum, Slow and fast Frequency hopping, Time hopping, Signal space dimensionality and processing gain, antijam characteristics, CDMA Applications, comparison of spread spectrum communication.	**10 Hours**
Module -5	
Detection and Estimation: Model of digital communication system, Gram-Schmidt orthogonalization procedure, **geometric** interpretation of signals, response of bank of correlators to noisy input, detection of known signals in noise, probability of error,	**11 Hours**

correlation receiver, matched filter receiver, estimation concepts and criteria, maximum likelihood estimation, wiener filter for waveform estimation.	

Course objectives: This course will enable students to:

- To teach the fundamental concepts of Control systems and mathematical modeling of the system
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system

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

Reference Books:

1. Simon Haykin, Digital Communications, John Wiley and Sons.
2. H.Taub and D.L.Schilling , Principles of Communication systems, MH
3. H.P.Hsu , Analog and Digital Communications, Schuam's outline series.
4. J G Proakis, Digital communications, MH
5. B P Lathi, Modern Digital and Analog Communication, 3rd edition.

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

Course Code	CO #	Course Outcome (CO)
18EC54	**CO1**	Analyze different PCM techniques in terms of SNR.
	CO2	Analyze the performance of digital communication systems in terms of BER.
	CO3	Analyze different carrier modulation techniques and its BER performance.
	CO4	Analyze properties of orthogonal codes and its use in spread spectrum Communication.
	CO5	Analyze the behavior of correlation receiver in the presence of noise.

19EC54: Digital Communication

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze different PCM techniques in terms of SNR	3	2	2					1		1		1	3	2	2
CO2	Analyze the performance of digital communication systems in terms of BER.	3	2	2					1		1		1	3	2	2
CO3	Analyze different carrier modulation techniques and its BER performance.	3	2	2	1				1		1		1	3	2	2
CO4	Analyze properties of orthogonal codes and its use in spread spectrum	3	2	2	1				1		1		1	3	2	2
CO5	Analyze the behavior of correlation receiver in the presence of noise.	3	3	2	2				1		1		1	3	2	2
Average		3	2.2	2	1.33				1		1		1	3	2	2

Embedded Microcontrollers

Embedded Microcontrollers			
Subject Code	19EC55	CIE	50
Number of Lecture Hours/Week	4Hours (Theory)	SEE	50
Total Number of Lecture Hours	42	SEE Hours	03
CREDITS –3:0:0:3			

Modules	Teaching Hours
Module -1	
The 8051 Microcontrollers: Micro-controllers and Embedded Processors, Overview of the 8051 Family. **8051 Programming(Assemble and C):** Inside the 8051, Introduction to 8051 Assembly Programming, Assembling and Running an 8051 Program, The Program Counter and ROM Space in the 8051, Data Types and Directives, 8051 Flag Bits and the PSW Register, 8051 Register Banks and Stack.,	**10 Hours**
Module -2	
8051 Addressing Modes and 8051 Instruction Sets. **8051 Timer and Counter Programming:** Programming 8051 Timers, Counter Programming.	**11 Hours**
Module -3	
Interrupt Programming: 8051 Interrupts, Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupt, Interrupt Priority in the 8051. **Real World Interfacing:** 8051 Interfacing to ADC/DAC, Sensors, Stepper motor, Keyboard and displays	**11 Hours**

Module -4	
Introduction to Embedded system Embedded system, Introduction to ARM architecture and Cortex – M processor, Cortex M architecture, Introduction to the TM4C family viz. TM4C123x launch pad I/O pins, cortex M assembly language, addressing modes and operands, parallel I/O ports, PLL, Timers, TM4C targeted applications.TM4C block diagram, address space, on-chip peripherals (analog and digital) Register sets, Addressing modes and instruction set basics.	**10 Hours**
Module -5	
Microcontroller fundamentals for basic programming: I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on TM4C, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming. Basic Timer, Real Time Clock (RTC), Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).	**10 Hours**
Graduate Attributes (as per NBA): • Engineering Knowledge. • Problem Analysis. • Design / development of solutions (partly). • Interpretation of data.	
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.** The 8051 Microcontrollers and Embedded Systems, MAZIDI and MAZIDI, Second edition, Pearson Education,1999	

2. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Create space publications ISBN: 978-1463590154.

3. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan W Valvano, Createspace publications ISBN-13: 978-1477508992

References:

1. THE 8051 Microcontroller, Kenneth Ayala, Second Edition, Thomson,2006

2. The Definitive Guide to ARM® Cortex®-M3, Second Edition, 2017 November, Joseph Yui.

3.http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded _Processors

4.http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_ Workshop

5.http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html

6..CC3100/CC3200 SimpleLink™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014–Revised August 2015.

Course objectives: This course will enable students to:

- Study the architecture of 8051 microcontrollers
- Study addressing modes instruction sets, timers and counters to program with 8051
- Understand interrupt programming and real world interfacing with 8051
- Study architecture of ARM Cortex M series and TM4C
- Study ARM fundamentals for basic programming

Course Code	CO #	Course Outcome (CO)
19EC55	CO1	Describe the 8051 microcontroller architecture, PSW and memory
	CO2	Analyze the working of 8051 timers and counters and program using 8051.
	CO3	Perform interrupt programming and Interface 8051 with real world I/O devices
	CO4	Describe the architecture of ARM and TM4C microcontroller and program for basic operations
	CO5	Analyze the TM4C modules and Program TM4C to interface real world modules

19EC55: Embedded Microcontrollers

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Describe the 8051 microcontroller architecture, PSW and memory	3	3										1	2		
CO2	Analyze the working of 8051 timers and counters and program using 8051.	3	3	2		3							1	2	2	2
CO3	Perform interrupt programming and Interface 8051 with real world I/O devices	3	3	3		3							1	2	2	2
CO4	Describe the architecture of ARM and TM4C microcontroller and program for basic operations	3	3	3		3							1	2	2	2
CO5	Analyze the TM4C modules and Program TM4C to interface real world modules	3	3	3		3							1	2	2	3
Average		3	3	2.75		3							1	2	2	2.25

Digital Signal Processing Lab

Subject Code	19ECL51	CIE=50
Number of Hours/Week	03 Hours (Practical)	SEE=50
Total Number ofLecture Hours	--	SEE Hours

Laboratory Experiments:

1. Introduction to MATLAB
2. Verification of sampling theorem
3. Generation of signals (Sinusoidal signals, Exponential signals etc.)
4. Operations on signals (Time shifting, time scaling and amplitude scaling)
5. Determine Z-transform and inverse Z-transform of discrete-time signals
6. Linear convolution, circular convolution.
7. Fourier representation of Discrete-time signals (DTFT, DFS), Properties of DTFT and DFS.
8. Discrete Fourier Transform(DFT), Properties of DFT
9. Linear filtering using DFT
10. DFT and IDFT using radix-2 FFT algorithm.
11. Design and implement digital IIR filters
12. Design and implement digital FIR filters

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

Course Code	**CO #**	**Course Outcome (CO)**
19ECL51	**CO1**	Sample and reconstruct analog signals.
	CO2	Compute linear and circular convolution in time domain and frequency domain.
	CO3	Compute DFT of a sequence using FFT algorithms.
	CO4	Design and implement digital IIR filters.
	CO5	Design and implement digital FIR filters using windows.

19ECL51: Digital Signal Processing Lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Sample and reconstruct analog signals.	3	2	2	1	2	1	1	2	3	2		1	3	3	2
CO2	Compute linear and circular convolution in time domain and frequency domain.	3	2	2	1	2	1	1	2	3	2		1	3	3	2
CO3	Compute DFT of a sequence using FFT algorithms.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO4	Design and implement digital IIR filters.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO5	Design and implement digital FIR filters using windows.	3	2	2	2	2	1	1	2	3	2		1	3	3	2

Embedded Microcontrollers Lab			
Subject Code	19ECL52	CIE	50
Number of Hours/Week	03 Hours (Practical)	SEE	50
Total Number of Lecture Hours	--	SEE Hours	03
CREDITS –01			

Laboratory Experiments:

I. Programming 8051 using Keil µVision

1. Develop programs using data movement instructions and arithmetic instructions
2. Develop programs on logical, bit manipulation instructions
3. Develop programs on branch and loop instructions
4. Programs 8051 timers and counters to perform specific functions
5. Develop programs to perform code conversions
6. Program 8051 to execute subroutine call and interrupts
7. Program 8051 to interface with real world modules (ADC/DAC/Stepper motor/ Display/Keyboard)

II. Programming Tiva C series TM4Cxx module with CC Studio and Energia IDE

1. Interfacing and Programming GPIO ports in 'C' using Tiva(LED Blinking and Push Button)
2. Interrupt programming through GPIO
3. PWM generation using PWM module on Tiva
4. Interfacing Potentiometer with Tiva GPIO
5. Speed control of RC motor controlled by potentiometer connected to Tiva GPIO

Course objectives: This course will enable students to:

1) Learn internal organization of 8051 microcontroller.
2) Learn programming of microcontroller and Timer/Counter.
3) Learn real-world interfacing
4) Learn to program TM4C Microcontroller
5) Learn to interface various modules with Tiva GPIO

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 forbreakup of marks.
Change of experiment is allowed only once and will be evaluated for 85% of the total marks.

Text Books:

1. The 8051 Microcontrollers and Embedded Systems, MAZIDI and MAZIDI, Second edition, Pearson Education,1999

2. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Create space publications ISBN: 978-1463590154.

3. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan W Valvano, Createspace publications ISBN-13: 978-1477508992

References :

1. Intel Reference Manual
2. www.keil.com
3. www.energia.nu
4. THE 8051 Microcontroller, Kenneth Ayala, Second Edition, Thomson,2006
5. The Definitive Guide to ARM® Cortex®-M3, Second Edition, 2017 November, Joseph Yui.
6. http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded _Processors
7. http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_ Workshop
8. http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html
9. CC3100/CC3200 SimpleLink™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014–Revised August 2015.

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

Course Code	CO #	Course Outcome (CO)
19ECL52	**CO1**	Develop programs to perform basic operations using 8051
	CO2	Develop programs to perform timer/counters operations and interrupt operations
	CO3	Develop program to interface 8051 with real world modules
	CO4	Program GPIO ports in ‘C’ using Tiva and perform basic operations
	CO5	Interface real world modules on Tiva

Subject with code: 19ECL52: Embedded Microcontroller lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Program for Data transfer, Arithmetic and logic operations.	3	3	3		3				3			1	3	2	2
CO2	Program for bit manipulation operations.	3	3	3		3				3			1	3	2	2
CO3	Program timer/counters.	3	3	3		3				3			1	3	2	2
CO4	Program for real world I/O devices	3	3	3		3				3			1	3	2	2
CO5	Program PPI for real world applications.	3	3	3		3				3			1	3	2	2
Average		3	3	3		3				3			1	3	2	2

DIGITAL COMMUNICATION LAB			
Subject Code	19ECL53	CIE	50
Number of Hours/Week	03 Hours (Practical)	SEE	50
Total Number ofLecture Hours	--	SEE Hours	02
CREDITS –01			

Course objectives:

- Use the fast Fourier Transform in a variety of applications including: Signal analysis and filtering.
- Choose and design digital IIR and FIR filters.

Laboratory Experiments:

1. Signal sampling and its reconstruction
2. Time division multiplexing of signals
3. Amplitude shift keying
4. Frequency shift keying
5. Phase shift keying
6. Differential phase shift keying
7. Quadrature phase shift keying
8. PN sequence generator

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 forbreakup of marks.
Change of experiment is allowed only once and will be evaluated for 85% of the total marks.

Reference Books:

1. A.V.Oppenheim and R.W.Schafer, Digital Signal Processing, PHI.
2.J.G.Proakis and D.G.Manolakis, Digital Signal Processing- Principals, Algorithms and Applications, PHI.
3. Rabiner and Gold, Theory and Applications of Digital Signal Processing, PHI
4. SanjitK.Mitra, Digital Signal- A computer- Based Approach, TMH.

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
19ECL53	**CO1**	Analyze the importance of sampling theorem in analog to digital Conversion.
	CO2	Analyze time division multiplexing in digital communication.
	CO3	Design and implement ASK, FSK and PSK modulation and demodulation.
	CO4	Design and implement DPSK and QPSK modulation and demodulation.
	CO5	Design and implement PN sequence generator.

19ECL53: Digital Communication Lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze the importance of sampling theorem in analog to digital Conversion.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO2	Analyze time division multiplexing in digital communication.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO3	Design and implement ASK, FSK and PSK modulation and demodulation	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO4	Design and implement DPSK and QPSK modulation and demodulation	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO5	Design and implement PN sequence generator	3	2	2	2	2	1	1	2	3	2		1	3	3	2
Average		3	2	2	2	2	1	1	2	3	2		1	3	3	2

VI Semester

ENTREPRENEURSHIP, MANAGEMENT AND FINANCE		
Subject Code	19EC61	CIE: 50
Number ofLecture Hours/Week	3 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		

Course objectives:

- The Meaning, Functions, Characteristics, Types, Role and Barriers of Entrepreneurship, Government Support for Entrepreneurship
- Management – Meaning, nature, characteristics, scope, functions, role etc.
- Engineers social responsibility and ethics
- Preparation of Project and Source of Finance
- Fundamentals of Financial Accounting
- Personnel and Material Management, Inventory Control

Modules	Teaching Hours
Module-1	
ENTREPRENEUR : Meaning of Entrepreneur; Functions of an Entrepreneur; Characteristics of an entrepreneur , Types of Entrepreneur; Intrapreneurs – an emerging class ; Role of Entrepreneurs in economic development; Barriers to entrepreneurship, Government Support for Innovation and Entrepreneurship in India - Startup-India, Make-in-India, PMMY, AIM , STEP, BIRAC, Stand-up India, TREAD.	**08 Hours**
Modules-2	
MANAGEMENT: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management, Roles of Management, Levels of Management, Henry Fayol - 14 Principles to Management, Engineers Social responsibility and Ethics.	**08 Hours**
Modules-3	
PREPARATION OF PROJECT AND SOURCE OF FINANCE: PREPARATION OF PROJECT: Meaning of project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; SOURCE OF FINANCE: Long Term Sources(Equity, Preference, Debt Capital, Debentures, loan from Financial Institutions etc) and Short Term Source(Loan from	**08 Hours**

commercial banks, Trade Credit, Customer Advances etc.	
Modules-4	
FUNDAMENTALS OF FINANCIAL ACCOUNTING: Definition, Scope and Functions of Accounting, Accounting Concepts and Conventions: Golden rules of Accounting, Final Accounts - Trading and Profit and Loss Account, Balance sheet.	**09 Hours**
Modules-5	
PERSONNEL MANAGEMENT, MATERIAL MANAGEMENT AND INVENTORY CONTROL: PERSONNEL MANAGEMENT: Functions of Personnel Management, Recruitment, Selection and Training, Wages, Salary and Incentives. MATERIAL MANAGEMENT AND INVENTORY CONTROL: Meaning, Scope and Objects of Material Management. Inventory Control- Meaning and Functions of Inventory control; Economic Order Quantity(EOQ) and various stock level (Re-order level, Minimum level, Maximum level, Average level and Danger level)	**09 Hours**

Course objectives:

- The Meaning, Functions, Characteristics, Types, Role and Barriers of Entrepreneurship, Government Support for Entrepreneurship
- Management – Meaning, nature, characteristics, scope, functions, role etc.
- Engineers social responsibility and ethics
- Preparation of Project and Source of Finance
- Fundamentals of Financial Accounting
- Personnel and Material Management, Inventory Control

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.

Reference Books:

1. Financial Accounting -B S RAMAN- United Publishers Manglore, Maheswar S N &Maheswari S K-Vikas Publishing House.
2. Management & Entrepreneurship- K R Phaneesh- Sudha Publications, ProfManjunatha& Amit kumar G – laxmi Publication, VeerbhadrappaHavina l-New Age International Publications.
3. Principles of Management First Edition (English, G. Murugesan), Laxmi Publications – New Delhi.

4. Industrial Organization & Engineering Economics-T R Banga & S C Sharma- Khanna Publishers, Dehli.

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

Course Code	CO #	Course Outcome (CO)
19EC61	**CO1**	Develop Entrepreneurship skills.
	CO2	Apply the concepts of management and Engineers Social responsibility & Ethics practice.
	CO3	Prepare project report & choose different Source of Finance.
	CO4	Apply Fundamentals of Financial Accounting and interpret the final accounts.
	CO5	Apply personnel management skills, Material and inventory control Techniques.

Subject with code: 19ECHU61: ENTREPRENEURSHIP, MANAGEMENT AND FINANCE

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1																
CO2																
CO3																
CO4																
CO5																

ANTENNA AND WAVE PROPOGATION		
Subject Code	19EC62	CIE: 50
Number ofLecture Hours/Week	4 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4:0:0:4		
Modules		**Teaching Hours**
Module-1		
Introduction to Antenna: Principle of radiation, isotropic radiator, radiation resistance, radiation pattern, beam width, bandwidth, directivity, gain, effective length of an antenna, relationship between gain and radiating efficiency, power gain, Frii's transmission formula.		**10 Hours**
Module-2		
Antenna arrays: Point sources, two element arrays of equal amplitude and same phase,equal amplitude and opposite phase and unequal amplitude and any phase, broad side and end fire arrays, multiplication of patterns, Binomial arrays, Effect of earth on vertical pattern Antenna Measurement: Methods of measuring impedance, field pattern, gain and directivity.		**10 Hours**
Modules-3		
Antenna Types: Yagi-Uda antenna, folded dipole antenna, parabolic reflectors, loop antenna, log periodic antenna, Helical antenna, horn antenna, patch antenna, slot antenna, lens antenna		**11 Hours**
Modules-4		
Radio wave propagation: Introduction, Radio waves, fundamental equation for free space propagation, modes of wave propagation, structure of atmosphere Ground wave propagation: Salient features, Field strength of ground wave at a distance, Attenuation characteristics of ground wave propagation		**10 Hours**
Modules-5		
Space wave propagation: Field strength relation for surface wave, miscellaneous aspects of space wave propagation, Radio Horizon, duct propagation, Atmospheric effects on space wave propagation Ionospheric wave propagation: characteristic parameters of wave propagation, critical frequency, maximum usable frequency, Actual height and virtual height, ray path and skip distance.		**11 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.

Reference Books:

1. John D Kraus, Antennas, Third Edition, McGrawHill
2. Jordan and Balmain, Electromagnetic waves and radiating systems, Second Edition, PHI
3. K D Prasad, Antenna and Wave propagation, Satyaprakashan Publishers, 2012.
4. C A Balanis, Antenna theory analysis and design, Third Edition, Wiley

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

Course Code	CO #	Course Outcome (CO)
19EC62	**CO1**	Analyze the various characteristic parameters of antennas.
	CO2	Analyze antenna arrays and determine gain, directivity and radiation pattern.
	CO3	Illustrate the construction and working of different types of antennas.
	CO4	Determine the effects of atmosphere on ground wave propagation.
	CO5	Determine the effects of atmosphere on space wave and ionospheric wave propagation.

19EC62: Antenna and Wave propagation

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze various parameters of antennas.	3	2						1		1		1	3		
CO2	Analyze antenna arrays and determine gain, directivity and radiation pattern.	3	3	2	2				1		1		1	3	2	2
CO3	Illustrate the construction and working of different types of antennas.	3	2	2	2				1		1		1	3	2	2
CO4	Determine the effects of atmosphere on ground wave propagation.	3	2	2	2				1		1		1	3	2	3
CO5	Determine the effects of atmosphere on space wave and ionospheric wave	3	2	2	2				1		1		1	3	2	3
Average		3	2.2	2	2				1		1		1	3	2	3.3

DIGITAL DESIGN USING VERILOG HDL		
Subject Code	19EC64	CIE: 50
Number of Lecture Hours/Week	03 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	52	SEE Hours: 03
CREDITS- 4:0:0:4		
Modules		**Teaching Hours**
Module-1		
Overview of Digital Design with VerilogHDL: EvolutionofCAD,emergenceofHDLs, typicalHDL-flow, whyVerilogHDL? trends in HDLs. **HierarchicalModelingConcepts:** Top-downandbottom-updesignmethodology, differences between modules andmoduleinstances,partsofasimulation, designblock,stimulusblock.		**10 Hours**
Modules-2		
Basic Concepts: Lexical conventions, datatypes, system tasks, compiler directives. **Modules and Ports:** Module definition, port declaration, connecting ports, hierarchical name referencing.		**10 Hours**
Modules-3		
Gate-Level Modeling: Modeling using basic Verilog gate primitives, description of and/or and buf/not type gates, rise, fall and turn-off delays, min, max, and typical delays. **Dataflow Modeling:** Continuous assignments, delay specification, expressions, operators, operands, operator types.		**11 Hours**
Modules-4		
Behavioural Modeling: Structured procedures, initial and always, blocking and non blocking statements, delay control, generate statement, event control, conditional statements, Multiway branching, loops, sequential and parallel blocks. **Tasks and Functions:** Differences between tasks and functions, declaration, invocation, automatic tasks and functions.		**11 Hours**
Modules-5		
Useful Modeling Techniques: Procedural continuous assignments, overriding parameters, conditional compilation and execution, useful system tasks. **Logic Synthesis with Verilog:** Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow,		**10 Hours**

Verification of Gate-Level Netlist.	

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.

Course Objectives: After studying this course, students will be able to:

- Learn different Verilog HDL constructs.
- Familiarize the different levels of abstraction in Verilog.
- Understand Verilog Tasks and Directives.
- Understand timing and delay Simulation.
- Understand logic synthesis using Verilog.

Text Books:

1. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis",PearsonEducation, Second Edition.

Reference Books:

1. Donald E. Thomas, Philip R Moorby, 'The Verilog Hardware Description Language", Springer Science+ Business Media, LLC, Fifth edition.
2. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL" Pearson (Prentice Hall), Second edition.
3. Padmanabhan, Tripura Sundari, "Design through Verilog HDL", Wiley, 2016 or earlier.

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

Course Code	CO #	Course Outcome (CO)	Blooms Level
	CO1	Develop Verilog programs in gate, dataflow (RTL) and behavioral levels of Abstraction.	L1,L2,L3
	CO2	Analyse the working of modules and port declarations.	L1,L2,L3
	CO3	Develop programs to demonstrate gate level and data flow modelling.	L1,L2,L3
	CO4	Develop programs using Verilog tasks, functions and directives.	L1,L2,L3,L4
	CO5	Perform timing and delay simulation and interpret the various constructs in logic synthesis.	L1,L2,L3

19EC63: Digital design using Verilog HDL

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Identify different styles of Verilog hardware description languages (HDL).	2	3	2	2			2				2	3	2	2	3
CO2	Design digital circuits using data flow description.	2	3	3	3			2				2	3	3	2	3
CO3	Design digital circuits using behavioral description	3	3	3	3			2				3	3	3	3	3
CO4	Design digital circuits using switch level description	2	3	3	3			3				3	3	3	3	3
CO5	Implement RTL models on FPGAs and Testing and Verification	2	3	3	3			2				3	3	2	2	3
	Average	2.2	3	2.8	2.8			2.2				2.6	3	2.6	2.4	3

Data Structures and Object-Oriented Programming using C++		
Subject Code	19EC64	CIE: 50
Number ofLecture Hours/Week	03 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		
Modules		**Teaching Hours**
Module-1		
PRINCIPLES OF OBJECT-ORIENTED PROGRAMMING: Introduction, Tokens, Expressions, control Structures, Functions in C++, parameters, Template function, classes and objects, Template class, constructors and destructors, operators overloading and type conversions.		**09 Hours**
Modules-2		
ADVANCED OBJECT-ORIENTED PROGRAMMING: Inheritance, Extending classes, Pointers, Virtual functions and polymorphism, File Handling Templates, Exception handling, Dynamic memory allocation.		**08 Hours**
Modules-3		
DATA STRUCTURES: Data Representation, Introduction, Linear list, Array representation, Linked representation, Arrays and Matrices **STACKS:**Definition, ADT, Array representation, Linked representation, Applications.		**08 Hours**
Modules-4		
QUEUES: Definition, ADT, Array representation, Linked representation, Applications. **SKIP LIST AND HASHING:** Dictionaries, Abstract Data Type, Linear list representation, Skip list representation, Hash Table Representation		**08 Hours**
Module-5		
BINARY TREES: Trees, Binary trees, properties of binary trees, representation of binary trees, common binary tree operations, binary tree traversal, ADT and class extensions. **PRIORITY QUEUES:**Definition, Abstract Data Type, Linear list, Heaps, leftist trees. Binary Search Tree, definitions, operations and implementation.		**9Hours**
Course Objectives: After studying this course, students will be able to: • To able to understand the features of C++ • To understand the different methods of organizing large amounts of data. To learn program in C++.		

- To efficiently implement the different data structures.
- To efficiently implement solutions for specific problems.

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. E. Balagurusamy, Object Oriented Programming with C++, McGraw Hill Company Ltd., 2007.
2. SartajSahni, Data Structures, Algorithms, and Applications in C++, McGraw Hill, Second edition.

Reference Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis
2. Michael T. Goodrich, Data Structures and Algorithm Analysis in C++, Wiley student edition, 2007.

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

Course Code	CO #	Course Outcome (CO)
19EC64	**CO1**	Apply various C++ constructs such as classes, functions, function overloading and dynamic memory management to develop programs.
	CO2	Develop programs using constructors, destructors, Inheritance to achieve code reusability and virtual functions to achieve run time polymorphism.
	CO3	Demonstrate program illustrations with data representations and data structures.
	CO4	Efficiently implement the concepts of Stacks, queues and Hashing.
	CO5	Analyze binary trees and priority queues and demonstrate the same with application programs.

19EC64: Data structures and Object Oriented programming using C++

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Examine the procedural and object oriented paradigm with concepts of parameters, classes, functions and objects.	3	3	2		2			1		1		1	3	2	2
CO2	Analyze the concept of overloading, virtual functions and polymorphism.	3	3	2		2			1		1		1	3	2	2
CO3	Illustrate data representations and data structures.	3	3	2	2	1			1		1		1	3	2	2
CO4	Implement Stacks, queues and Hash functions.	3	3	2	2	1			1		1		1	3	2	2
CO5	Analyze binary trees and priority queues.	3	3	3	3	2			1		1		1	3	2	2
		3	3	2.2	2.3	1.8			1		1		1	3	2	2

Internet of Things		
Subject Code	19EC651	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		
Modules-1		**Teaching Hours**
Introduction & Overview of Internet of things, The Internet of things today and tomorrow, Vision of internet of things,An IoT architecture outline, Functional blocks of IOT,industrial IOT, IOT enabled Smart devices in market,Application areas for IOT,Challenges in IOT.Hardware and Software tools required for IOT application development, Overview of IOT based on Texas instruments Hardware platforms and IDE's for development. **Case Study:** SimpleLink ™ Wi-Fi ® Enabled Electronic Smart Lock.		**08 Hours**
Modules-2		
Internet/Web and Networking Basics, Introduction to internet & network topologies,TCP/IP protocol, TCP/IP Layers and their relative Protocols, IP addressing(IPV4),IP Address Classification & Subnetting, Local IP , Gateway IP and DNS,TCP & UDP Communication, Access point and Station model, Wireless networks, Encryption standards and signal strength of WiFi network, Overview of MAC Address, EnergiaWiFi Library API's for Texas Instruments Boards. **Case Study:** Connected microcontrollers essential to automation in buildings		**08 Hours**
Modules-3		
Web servers and Client Communication, Introduction to a Web server and its types, Role of servers over internet, Port numbers, Socket Communication, Wi-Fi Web Client, Client server Communication model with Example, Overview of HTTP protocol, HTTP based web server, Sensor interfacing with network, basics of HTML, Client and Server class API's.		**8 Hours**
Modules-4		
Cloud Communication in IOT,IOT device to cloud storage communication Model,need of Cloud services in IOT,Different Cloud storage services available today,Cloud Data processing and frame format,Role of Smart		**8 Hours**

phones in IOT, Examples on Home automation and Smart city development,Introduction to clouds like Temboo,Blynk,Pubnub etc. Case Study : Advances in bio-inspired sensing help people lead healthier lives.	
Modules-5	
IOT Platform and Application development, Remote Monitoring & Sensing, Remote Controlling,Application development using MQTT Protocol, Sensors and sensor Node and interfacing using Texas instruments Embedded target boards(TM4C12xx & CC31xx),IoT applications in home, infrastructures, Healthcare,Transport, buildings, security, Industries, and other IoT electronic equipments, Adapting IPV6 for IOT Requirement(overview).	**10 Hours**

Course objectives:

- This course imparts knowledge on, introduction to IOT, its complete architecture & internet Protocols involved to enable IOT communication over the network .
- The course also offers an introduction to Texas instrument's IoT platforms, end devices, networks and cloud services.
- Using case analysis , assignments ,Labs & projects students will acquire skills necessary to identify building blocks of an IOT application.

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. Internet of Things: Converging Technologies for Smart Environments and Integrate Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers.
2. Embedded Ethernet And Internet Complete (Designing and Programming Small Devices for Networking)by Jan Axelson.
3. Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach.
4. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur,AdamDunkels, Morgan Kuffmann.

References Book:

1. Internet of Things (IoT): A vision, architectural elements, and future directions JayavardhanaGubbia, Rajkumar Buyyab,∗, Slaven Marusic a, MarimuthuPalaniswami

2. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

E books and online course materials:

1. http://www.ti.com/ww/en/internet_of_things/iot-overview.html.
2. http://energia.nu/reference/
3. http://www.ti.com/lit/ug/swru371b/swru371b.pdf
4. http://www.ti.com/lit/ug/swru371b/swru371b.pdf
5. http://www.ti.com/lit/ds/symlink/cc3100.pdf
6. http://www.ti.com/wireless-connectivity/simplelink-solutions/overview/overview.html.
7. https://www.hivemq.com/blog/mqtt-essentials-part2-publish-subscribe.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
	CO1	Identify issues and design challenges in IoT applications.
	CO2	Analyze various network topologies and relative internet protocols
	CO3	Analyze the role of web server and develop communication models
	CO4	Develop applications to illustrate cloud communication in IOT
	CO5	Develop case studies to demonstrate IOT based applications

19EC651: Internet of Things

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Identify issues and design challenges in IoT applications.	2	3	2	2			2				2	3	2	2	3
CO2	Analyze various network topologies and relative internet protocols	2	3	3	3			2				2	3	3	2	3
CO3	Analyze the role of web server and develop communication models	3	3	3	3			2				3	3	3	3	3
CO4	Develop applications to illustrate cloud communication in IOT	2	3	3	3			3				3	3	3	3	3
CO5	Develop case studies to demonstrate IOT based applications	2	3	3	3			2				3	3	2	2	3
Average		2.2	3	2.8	2.8			2.2				2.6	3	2.6	2.4	3

Electromagnetic Interference and Electromagnetic Compatibility		
Subject Code	19EC652	CIE: 50
Number of Lecture Hours/Week	03 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3:0:0:3		
Modules		**Teaching Hours**
Module-1		
Importance of EMI and EMC, Introduction to radiated and conducted emissions testing and limits, Electromagnetic field theory: Description of electromagnetic disturbances, classification based on frequency, transmission and character, Unintentional antennas: Near field vs far field, pre-compliance testing.		**08 Hours**
Module-2		
Coupling mechanisms: Current loops, choosing a PCB stack up, Differential mode and common mode noise in digital circuits: Decoupling capacitor selection, values & resonant frequencies, Decoupling capacitor placements & routing: Demonstration, Dielectrics, Vias placement, Return paths.		**08 Hours**
Modules-3		
Techniques to optimize power delivery network, Reduction techniques: Reducing internal EMI, Introduction to grounding, EMI filter circuits, Insertion loss EMI filter design, Cable radiation and interference, EM coupling wiring layout and PCB design considerations, shielding-coaxial cables, shielding of equipment, Component placement and zoning for optimal EMI performance in mixed signal circuits.		**09 Hours**
Modules-4		
Introduction to signal integrity and EMI, Impedance mismatches, Reflections, vias and manufacturing effects, Termination methods and routing topologies, Crosstalk and guarding, causes of EMI from high speed digital circuits., SMPS design for low conducted emissions, need for Shielding, Analysis using logic analyzer.		**08 Hours**
Modules-5		
Introduction to IEEE Standards used, EMI Measurement: EMI measuring instruments, basic terms, spectrum analyzers, EMC standards, EMI testing equipment, EMI in power electronics equipment: EMI from power semiconductor devices, conducted and radiated noise.		**09Hours**
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.
Reference Books: 1.Electromagnetic Compatibility Design Guide", Tecknit 2. Noise Reduction Techniques In Electronic System: H.W.Ott 3. EMI Control Methodology and Procedures: Donald.J. White 4. New Dimensions in Shielding, Robert B. Cowdell, IEEE transactions on ElectromagneticCompatibility, 1968 March

Course outcomes: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
19EC652	**CO1**	Analyze different types of electromagnetic distribution in electric and electronicdesign.
	CO2	Mitigate common mode and differential mode noise in digital circuits.
	CO3	Apply reduction techniques to reduce EMI problems and optimize power delivery.
	CO4	Analyze signal integrity against impendence mismatch, crosstalk and guarding in high speed digital circuits.
	CO5	Implement IEEE EMI standards in electric and electronic design.

19EC652: Electromagnetic Interference and Electromagnetic Compatibility

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze different types of electromagnetic distribution in electric and electronic design.								1		1		1			
CO2	Mitigate common mode and differential mode noise in digital circuits.								1		1		1			
CO3	Apply reduction techniques to reduce EMI problems and optimize power delivery.								1		1		1			
CO4	Analyze signal integrity against impendence mismatch, crosstalk and guarding in high speed digital circuits.								1		1		1			
CO5	Implement IEEE EMI standards in electric and electronic design.								1		1		1			
Average									1		1		1			

JAVA PROGRAMMING		
Subject Code	**19EC653**	**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 course introduces Java and its applications • Gives an insight into class, objects and methods. • Gives an introduction to inheritance, packages and exception handling. • Imparts knowledge regarding multithread programming.		
Modules-1		**Teaching Hours**
Introduction to JAVA: Overview of JAVA, Java applications, JDK, Compiling JavaProgram, Java Interpreter, Byte code, JVM, Simple JAVA Programs. Primitive, non-primitive data types, Type casting, Arrays and strings. **Operators & Expressions:** Arithmetic operators, Bitwise operators, Relational Operators,Logical Operators, The Assignment Operators, The? : operators, Operator precedence; Logical expression; Control statements, Selection statements, Iteration statements, Jump statements		**08 Hours**
Modules-2		
Class, objects, Methods: Classes in Java, Class fundamentals, Super classes, Constructors; Creating instances of class; Methods; Method overloading; **Inheritance:** Simple, Multiple and multilevel inheritance, overriding, overloading, usingabstract classes, using final with inheritance.		**09 Hours**
Modules-3		
Packages: Creating package, Access package, importing package; defining Interfaces, implanting interfaces. **Exception Handling:** Exception type, Multiple catch statements, uncaught exceptions, usingtry and catch block, Nested try statements, Multiple catch statements.		**08 Hours**
Modules-4		
Event Handling: Event handling mechanisms, The delegation event model, event classes, source of events, Event listener interfaces. **Multithread Programming :** Java thread model, thread priorities, Synchronization,		**08 Hours**

Messaging, thread class and runnable interface, main thread, creating a thread, multiple threads, stopping and blocking a thread, Thread life cycle, thread methods, thread exceptions	
Modules-5	
Applet Programming : The Applet Class: Applet basics, Two types of Applets; Applet Architecture; An Applet skeleton; Applet lifecycle, Simple Applet display methods; Requesting repainting; Using the Status Window; Designing the web page, The HTML APPLET tag; Adding applet to HTML File, Passing parameters to the APPLETS; getDocumentbase() and showDocument(), The AudioClip Interface; The AppletStub Interface; Output to the Console. **Managing I/O Files in JAVA:** Stream classes, byte stream classes, character stream classes,other I/O classes. I/O exceptions, Reading writing character, Reading writing bytes.	**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. Java the Complete Reference – Herbert Schildt, 7th Edition, Tata McGraw Hill, 2007.
2. Programming with Java 4th Edition – E. Balaguruswamy, Tata McGraw Hill.

Reference Books:

1.Introduction to Java Programming: Y. Daniel Liang, 6th Edition, Pearson Education, 2007. Wesely,2005.
2.Introduction to Java Programming: Y. Daniel Liang, 6th Edition, Pearson Education, 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)
	CO1	Demonstrate the object oriented programming paradigm using JAVA.
	CO2	Implement inheritance, dynamic polymorphism and packages using class and objects.
	CO3	Implement Exception handling mechanism using JAVA Programming principles.
	CO4	Implement event handling and Multithread programming techniques
	CO5	Implement applets and understand the IO streams

19EC653: Java Programming

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Analyze the object-oriented programming paradigm using JAVA.	3	2	2		2							1	3	3	2
CO2	llustrate inheritance, dynamic polymorphism and packages using class and objects.	3	3	3		3							1	3	3	2
CO3	Develop applications based on exception handling mechanism.	3	3	3		3							2	3	3	2
CO4	Analyze event handling and Multithread programming techniques.	3	3	3		3							2	3	3	2
CO5	Analyze applets and IO streams.	3	3	3		3							3	3	3	2
		3	2.8	2.2		2.8							2.2	3	3	2

DIGITAL SYSTEM DESIGN USING VERILOG HDL LAB		
Subject Code	19ECL61	CIE: 50
Number ofLecture Hours/Week	02 Hours (Practical)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 0:0:2:1		

1. Write Verilog code to realize all the basic and universal logic gates.
2. Write Verilog code to design of combinational circuits.
3. Write Verilog code to describe the function of a 1-bit full adder/Subtractor using all three modeling styles.
4. Write Verilog code for a 4-bit Adder/ subtractor using the module defined in question 3 as a component.
5. Write Verilog code to model a 8, 16 and 32 bit ALU.
6. Write Verilog code to design SR, JK, D and T flip flops and also master slave JK flip flop.
7. Write Verilog code to design a code converter.
8. Write Verilog code to design 4 bit binary, hexadecimal and BCD counter.
9. Write Verilog code to design 4 bit bidirectional shift register.
10. Design of real time applications for interfacing with external world.

Course Objectives: After studying this course, students will be able to:

- Design different combinational circuits in Verilog.
- Design flip flops in Verilog.
- Design registers in Verilog.
- Design of real time applications for interfacing with external world.

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: **On completion of the course, the student will have the ability to:**		
Course Code	**CO #**	**Course Outcome (CO)**
19ECL61	**CO1**	Realize the fundamental digital logic circuits using various Verilog HDL descriptions and implement on FPGA.
	CO2	Design and develop combinational logic circuits using Verilog HDL and implement on FPGA.
	CO3	Analyze and verify using Verilog various flip flops and implement on FPGA.
	CO4	Develop and design counters and shift registers to implement on FPGA using Verilog.
	CO5	Develop Verilog HDL descriptions for real time applications.

19ECL61: DIGITAL SYSTEM DESIGN USING VERILOG HDL LAB

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Realize digital logic gates using various verilog HDL descriptions and implement on FPGA.	3		2						2			3	2		
CO2	Design combinational logic circuits using Verilog HDL and implement on FPGA.	3	3	3	2	2				2			3	3	2	
CO3	Analyze and implement various flip flops using verilog and test on FPGA.	3	3	3	2	2				2			3	3	2	
CO4	Design counters and shift registers and implement on FPGA using verilog.	3	2	3	3	3				2			3	3	3	3
CO5	Implement Verilog HDL descriptions for real time applications.	3	3	3	2	3				3			3	3	3	3
Average		3	3	2.8	2.25	2.5				2.2			3	2.8	2.5	3

DATA STRUCTURES USING C++ LAB		
Subject Code	19ECL62	CIE: 50
Number of Lecture Hours/Week	02 Hours (Practical)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 0:0:2:1		

1. Develop C++ program that uses a function to perform the following
   i. Create a node
   ii. Implement a singly/doubly/circularly linked list of Integers
   iii. C++ program for traversal of a linked list
   iv. Find nth node in linked list
   v. Insert/Delete elements in linked list. Display the contents of the list after Insertion/deletion
2. Develop C++ programs to perform the following with stacks
   i. Implement stack using linked list
   ii. Implement stack using two queues
   iii. Implement simple stack operations to find min elements
   iv. Add/ delete elements (push and pop) from stack
   v. Solve the tower of Hanoi problem using recursion
   vi. Convert a given infix expression into postfix expression using stack.
3. Develop C++ programs to perform the following on Queues
   i. Array implementation of queue
   ii. Implement queue using linked list
   iii. Implement queue using two stacks
   iv. Implement circular queue
   v. Implement doubly ended queue
   vi. Implement double ended queue ADT using an array using a singly/doubly linked list.
   vii. find front and rear in a linked queue
4. Write a C++ program that uses function template to perform the following,
   i. Build a binary tree
   ii. Traverse the tree in inorder/ preorder/ postorder
   iii. Program to implement insertion/deletion from binary tree.
   iv. Program to check binary tree is complete or not
   v. program to find height of tree
5. Develop and implement an expression tree for a given valid postfix expression and evaluate the expression tree.
6. Write a C++ program that uses function template to perform the following,
   i. Implement heap
   ii. Implement Min/Max Heap/Binary heap

iii. Search for a key element in a list of sorted elements using binary search.

Course Objectives: This course enables the students to

• Develop and implement Linear data structures and their applications such as stacks, queues using static memory allocation.

• Develop and implement Linear data structures such as linked lists using dynamic memory allocation.

• Explore the applications of linked lists, develop and implement them.

• Develop and implement Non-Linear data structures such as trees and their applications.

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

Course Code	CO #	Course Outcome (CO)
19ECL62	**CO1**	Apply the knowledge of linked lists to design and develop solutions to given problems.
	CO2	Design and develop Linear data structures like Linked Lists using dynamic memory allocation technique.
	CO3	Apply the knowledge of linked lists to design and develop solutions to given problems.
	CO4	Design and develop Linear data structures like Stack, Queue using memory allocation techniques and explore their applications.
	CO5	Apply the knowledge of dynamic memory allocation technique to develop and implement non-linear data structures like Trees, Heaps and their applications.

19ECL62: Data structure using C++ Lab

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Develop program and Implement singly and doubly linked list.	2	2	2										2	2	1
CO2	CO2: Write program to implement various stack operations.	2	2	2										2	2	1
CO3	CO3: Write program to create binary search tree and implement operations on binary tree	2	2	2										2	2	
CO4	Implement searching and sorting algorithms.	3	2	3										2	2	
CO5	Develop program to perform hashing operations and tree traversal.	2	2	2										2	2	
	Average	2.2	2	2.2										2	2	1

MINI PROJECT			
Subject Code	196ECL63	CIE	50
Number of Hours/Week	02 Hours	SEE	50
Total Number of Lecture Hours	--	SEE Hours	03
CREDITS –01			

Course objectives: This course will enable students to:

- Improve the practical skills
- Collect the information of project
- Analyze and select appropriate method
- Plan and implement project
- Document and present the project

Each batch comprising of two to four students shall identify mini project related to the curriculum of study.

Students are supposed to carry out the following during the semester

1. Selecting the project which is having some functionality.
2. Collect the information about project
3. Develop, test and implement project
4. Document the work.

Each group shall submit a project report at the end of sixth semester. The project report should contain Literature survey, Design, Engineering documentation and Test results. Innovative design concepts, Reliability considerations, Its usefulness in practice taken care of in the project shall be given due weightage.

Guidelines for Evaluation:

1. Attendance and regularity,
2. Understanding and involvement.
3. Level of completion, Originality and Functionality.
4. Project report.

Graduate Attributes (as per NBA):

• Engineering Knowledge.
• Problem Analysis.
• Design / development of solutions (partly).
• Interpretation of data.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot

with code: 19ECL63:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PS 2
mplement the layout/schematic Design) .	3	3	2	1	3				3		3	1	2	2
Testing of the individual modules.	2	2			2				3			1	2	2
Record the results and analyze.	2	3			2		2		3			1	2	2
Perform the review									3	3				
Demonstration of the work done Viva Voce)	1	1		1	2	3	3	3	3	3	3	1	2	2

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

.

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