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 in 1958.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 Defence 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

- To provide a high-quality educational experience for students with values and ethics that enables them to become leaders in their chosen profession.
- To explore, create and develop innovations in engineering and science through research and developmental activities.
- 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 Analyse 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 modelling 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 theEngineering 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 to engage 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.

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2022-23 to 2025-26

Department of Electronics and Communication Engineering

(Effective from the academic year 2022-23)

III Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	BS	21MA31C	Numerical Methods and Integral Transforms	Mathematics	03	-	-	-	03	50	50	100	3
2	PC	21EC32	Electronics Circuits-I	ECE Dept	03	-	-	-	03	50	50	100	3
3	PC	21EC33	Digital Electronics	ECE Dept	03	-	-	-	03	50	50	100	3
4	PC	21EC34	Network Analysis	ECE Dept	03	-	-	-	03	50	50	100	3
5	HSMS	21HU35	Constitution of India, Professional Ethics and Cyber Law	Humanities	02	-	-	-	02	50	50	100	1
6	Internship	21INT36	Summer Internship – I	ECE Dept	-	-	-	-	03	50	50	100	2
7	AEC	21ECAE36A	Python Programming (Hands on)	ECE Dept	-	-	-	-	02	50	50	100	1
8	UHV	21UHV36B	Universal Human Values-1		02	-		-	02	50	50	100	1
9	PC	21ECL31	Electronic Circuits-I Lab	ECE Dept	-	-	02	-	03	50	50	100	1
10	PC	21ECL32	Digital Electronics Lab	ECE Dept	-	-	02	-	03	50	50	100	1
11	PC	21ECL33	Network Analysis Lab	ECE Dept	-	-	02	-	03	50	50	100	1
Total										**550**	**550**	**1100**	**20**

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2022-23 to 2025-26

Department of Electronics and Communication Engineering

(Effective from the academic year 2022-23)

IV Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PC	21EC41	Signals & Systems	ECE Dept	03	-	-	-	03	50	50	100	3
2	PC	21EC42	Electronics Circuit–II	ECE Dept	03	-	-	-	03	50	50	100	3
3	PC	21EC43	Data Structures and algorithm using C++	ECE Dept	03	-	-	-	03	50	50	100	3
4	PC	21EC44	Embedded Microcontroller	ECE Dept	03	-	-	-	03	50	50	100	3
5	HSMS	21KAK45	Samskrutika Kannada	Humanities	02	-	-	-	1.5	50	50	100	1
		21KAN45	Balake Kannada										
6	AEC	21ECAE46A	Life Sciences (Organic farming)	ECE Dept	-	-	-	-	02	50	50	100	2
7	AEC	21ECAE46B	Verilog HDL Programming	ECE Dept	-	-	-	-	03	50	50	100	1
8	AEC	21UHV46C	Universal Human Values-II		-	-	-	-	02	50	50	100	1
9	PC	21ECL41	Electronic Circuits – II Lab	ECE Dept	-	-	02	-	03	50	50	100	1
10	PC	21ECL42	Data Structures and algorithm using C++ Lab	ECE Dept	-	-	02	-	03	50	50	100	1
11	PC	21ECL43	Embedded Microcontroller Lab	ECE Dept	-	-	02	-	03	50	50	100	1
Total					-	-	-	-	-	**550**	**550**	**1100**	**20**

ELECTRONIC CIRCUITS-I		
Subject Code	21EC32	CIE: 50
Number of LectureHours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDIT- 3		

Course objectives:

- Various Applications of diode circuits
- Biasing of BJTs and FETs
- Design and analysis of BJT and FET
- Design and analysis of oscillators.
- Analysis of power devices

Module#	Teaching Hours
Module-1	**8 Hours**

Diode characteristics: Introduction, load line analysis, diode approximations, series diode configuration with DC inputs, parallel and series configurations,
Diodes applications: AND / OR gates, clippers, clampers, zener diodes as regulators and voltage multiplier circuits.

Module-2	**09 Hours**

Bipolar Junction transistor: Introduction, transistor construction, configurations and input output characteristics,
Transistor biasing: operating point, fixed bias circuit, emitter stabilized bias circuits and voltage divider bias analysis.
Small signal analysis: BJT transistor modelling and hybrid equivalent model of small signal amplifier configuration and deriving voltage gain, input impedance and output impedance,

Module-3	**09 Hours**

Power Amplifiers: Class A large signal amplifiers, second harmonic distortion Higher order harmonic generation, the transformer coupled audio power amplifier, efficiency, push pull amplifiers, class B and class C amplifiers.

FET biasing: fixed bias configurations, self-bias configurations, voltage divider biasing.
Small signal analysis: small signal model of JFET, FET amplifier design and analysis.

Module-4	**08 Hours**

Feedback and Oscillator circuits: Feedback concepts, Analysis of different feedback topologies,practical feedback circuits, feedback amplifier, phase and frequency considerations,
Oscillators: operation, R C phase shift oscillator, Wien bridge oscillator, tuned oscillator circuits, crystal oscillator.

Module-5	**08 Hours**

Multilayer devices:SCR, DIAC and TRAIC characteristics and ratings, UJT operation and characteristics. UJT as a fining circuit,
Power Converters: Half and full wave basic controlled rectifiers, step down and step up chopper, single phase half and full bridge inverters.

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
3. Muhammad H Rashid, "Power Electronics",PHI,2nd edition 2004

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, 5th editon, 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)
21EC32	CO1	Analyse and apply diode circuits for various applications.
	CO2	Design and analyse transistor biasing circuits and amplifiers.
	CO3	Analyse FET biasing circuits and amplifiers
	CO4	Analyse feedback amplifiers and design oscillators.
	CO5	Analyse and apply power devices for various applications.

21EC32: Electronic Circuits-I

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse and apply diode circuits for various applications.	3	3	1					1		1		1	3	2	2
CO2	Design and analyse transistor biasing circuits and amplifiers.	3	3	2					1		1		1	3	2	2
CO3	Analyse FET biasing circuits and amplifiers	3	3	2					1		1		1	3	2	2
CO4	Analyse feedback amplifiers and design oscillators.	3	3	3					1		1		1	3	2	2
CO5	Analyse and apply power devices for various applications.	3	3	2					1		1		1	3	2	2
Average		3	3	2					1		1		1	3	2	2

DIGITAL ELECTRONICS		
Subject Code	21EC33	CIE: 50
Number of LectureHours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3		

Course objectives:

- Study Boolean algebra, various minimization techniques.
- Design standard Combinational circuits.
- Design sequential circuits and Asynchronous counters.
- Design Synchronous counters/circuits.
- Realization of Programmable Logic Devices

Module#	Teaching Hours
Module-1	**08 Hours**

Boolean Algebra and Minimization techniques: Boolean postulates and laws, minimization of Boolean expressions, minterm, maxterm, canonical forms, minimization techniques- Karnaugh map, VEM technique, Quine-McCluskey technique.

. ***Self-Study**: Revision of basic gates.*

Module-2	**09 Hours**

Combinational Circuits:
Design procedure, parallel binary adder and subtractor, carry look ahead adder, BCD adder, binary multiplier, multiplexer and demultiplexer/decoder 7-segment decoder/driver, encoder, parity checker, parity generators, code converters, magnitude comparators.

***Self-study**: Realisation of standard Combinational Circuits using Verilog HDL.*

Module-3	**09 Hours**

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 and state transition table, triggering types, Asynchronous/ripple counters using Flip-Flops, using counter ICs,

***Self-study**: Realisation of Flip-Flops, Ripple counters using Verilog HDL*

Module-4	**08 Hours**

Synchronous counters:Design of synchronous counters,state table, state diagram, state minimization, state assignment,decade counter, mod- n counter, up/down counters using Flip-Flops,
Synchronous Sequential Circuits: General model, classification, design of algorithmic state machine, analysis of synchronous sequential circuits. (Mealy and Moore machines)

***Self-study**: Realisation of Synchronous counters using Verilog HDL.*

Module-5	**08 Hours**

Registers, Memory devices, Programmable Logic Devices:
Registers, shift registers, universal shift registers, classification of memories,
Programmable Logic Devices: PROM, PAL, PLA, Field Programmable Gate Arrays (FPGA),realisation of combinational logic circuits using ROM, PLA, PAL.

***Self-study**: Realisation of Shift Registers using Verilog HDL.*

*Self-study topics mentioned at the end of each module,are not for exams but the Faculty concerned should introduce Verilog HDLdesign tool to the students and motivate the students to develop more applications relevant to the course using Verilog tool.

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.
3. R.P.Jain, "Modern Digital Electronics",4thEdn, Tata McGraw Hill

Reference Books:

1. Morris and Miller. "Designing with TTL integrated circuits", McGrawHill
2. Samir Palnitkar, Verilog HDL A guide to Digital Design and Synthesis.
3. ZviKohavi, "Switching and finite automata theory" Cambridg e university press 3 rd Edition
4. Malvino and Leach, " Digital principles and applications" TATA McGraw Hill 8 th Edition

E books and online course materials: NPTEL

Course outcomes:
On completion of the course, the student will be able to**:**

Course Code	CO #	Course Outcome (CO)
21EC33	**CO1**	Apply different methods to minimize Boolean expressions.
	CO2	Design and realize Combinational circuits.
	CO3	Design and realize sequential circuits, Asynchronous counters
	CO4	Design and Analysesynchronouscounters, sequential circuits.
	CO5	Analyse shift Registers and realization of programmable logic devices.

21EC33: Digital Electronics

CO#	CO	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply different methods to minimize Boolean expressions.	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	Analyse synchronous and asynchronous sequential circuits.	3	3	3					1		1		1	3	3	2
CO5	Analyse shift Registers and realization of programmable logic devices.	1	1	2					1		1		1	3	3	2
Average		2.6	2.4	2.8					1		1		1	3	3	2

NETWORKS ANALYSIS		
Subject Code	21EC34	CIE: 50
Number of Lecture Hours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS–3		

Course objectives:

- To introduce loop, mesh analysis and graph theory.
- To apply and analyse various network theorems in solving the problems related to electrical circuits, transient analysis.
- To describe Z, Y, ABCD, h- parameters.
- To describe various types of passive filters and attenuators.
- To describe the resonant circuits

Module #	Teaching Hours
Module-1	**08 Hours**

Network Equations: Kirchhoff's laws, The number of network equations, Source transformation, examples of the formulation of network equations loop variable analysis, node variable analysis, Duality. Graph theory and equations

Module-2	09 Hours

The Laplace transforms Impedance function and Network theorems: The Laplace transformation, basic theorems, examples, partial fraction expansion. The concept of complex frequency, transform impedance and transform circuits.

Theorems: Superposition, Thevenin's, Norton's, Maximum power transfer and Reciprocity theorems

Module-3	08 Hours

Two port network parameters: Relationship of two port variablesZ, Y, ABCD, h-parameters, interrelation among parameters, condition for symmetry and reciprocity, Parallel and cascade connection of networks.

Module-4	08 Hours

Filters: The neper, the decibel, Characteristic impedance of symmetrical network, Current and Voltage ratios as exponentials, The propagation constant, Properties of symmetrical networks, Filter fundamentals, Constant-K low pass and high pass filters, Band pass filters.

Attenuators: Symmetrical T,π,lattice and bridge type attenuators, Asymmetrical T type attenuator

Module-5	09 Hours

Resonance: Definition of Q, the factor of merit ,series resonance, bandwidth of the series resonant circuit, parallel resonance, conditions for maximum impedance, currents in anti-resonant circuits, impedance variation with frequency; universal resonance curves, bandwidth of anti-resonant circuits, reactance curves

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 Third edition,2005
2. Hayt. W. H. & J. E. Kemmerly, "Engineering Circuit Analysis", TMH Eighth edition
3. John D. Ryder, Networks, lines & fields, PHI second edition,2010

Reference Books:

1. William D Stanley, "Network Analysis with Applications", Pearson Education Fourth edition, 2002.
2. Roy Choudhary D, "Network and systems", New age Publications First edition, Reprint 2005
3. Umeshsinha "Transmission lines & Network" Tech India publications fifth edition,1998

E books and online course materials:

https://www.pdfdrive.com/download.pdf?id=158109904&h=737affc1e0e362db88f262b63a78c783&u=cache&ext=pdf

Course outcomes: On completion of the course, the student will be able to:

Course Code	CO #	Course Outcome (CO)
21EC34	CO1	Apply circuit laws and graph theory to reduce circuit complexity.
	CO2	Apply Network theorems to analyse AC and DC circuits,
	CO3	Compute Two-Port network parameters and their relationship, describe network function.
	CO4	Design and analyse passive filters and Attenuators.
	CO5	Design and analyse Resonant circuits

21EC34: Networks Analysis

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply circuit laws and graph theory to reduce circuit complexity.	3	3	2					1		1		1	3	3	2
CO2	Apply Network theorems to analyse AC and DC circuits,	3	3	2					1		1		1	3	3	2
CO3	Compute Two-Port network parameters and their relationship, describe network function.	3	3	2					1		1		1	3	3	2
CO4	Determine the line parameters	3	3	2	1				1		1		1	3	3	2
CO5	Analyse and design different impedance matching techniques.	3	3	2	2				1		1		1	3	3	2
Average		3	3	2	1.5				1		1		1	3	3	2

PYTHON PROGRAMMING (HANDS-ON)		
Subject Code	21ECX36A	CIE: 50
Number of LectureHours/Week	02Hrs(Theory)	SEE: 50
Total Number of Lecture Hours	24	SEE Hours: 03
CREDITS–1		

Course objectives:

- Understand the basics of python programming.
- Program using control structures and functions.
- Understand and program with strings and lists
- Understand Dictionaries, tuples and files
- Understand the concepts of OOP's

Module#	Teaching Hours
Module-1	**4 Hours**

Introduction: History of Python Programming, thrust areas of python, Installing python IDE (Pycharm IDE). Creating and running first python project. Parts of python programming language: Identifiers, Keywords, Statements and expressions, variables, operators, data types, Indentation, Comments, Read input and print output, Type conversion. Programming examples.

Module-2	4 Hours

Control Flow Statements: Sequential, conditional and Iterational, Continue and break, exceptional handling using try and except.

Functions: Built-in functions, modules, function definitions and calling the functions, return statements and void functions, scope of variable, default parameters, keyword arguments and command line arguments. Programming examples.

Module-3	5 Hours

Strings: Creating and storing strings, basic string operations, accessing string characters, string slicing and joining, string methods, formatting strings.

Lists: Creating lists, basic list operations, indexing and slicing in lists, built-in functions used on lists, list methods.

Module-4	5 Hours

Dictionaries:Creating Dictionary, Accessing and Modifying *key:value*Pairsin Dictionaries, The*dict()* Function. Built-In Functions Used on Dictionaries

Tuples and Sets: Creating Tuples, BasicTuple Operations, The*tuple()* Function, Indexing and Slicing inTuples. Built-In Functions Used on Dictionaries. Relation, Relation between Tuples and Dictionaries.

Files: Types, Creating and reading text data

Module-5	5 Hours

Object Oriented Programming: Classes and Objects, creating classes in python, creating objects in python, The constructor method, classes with multiple objects, class attributes and data attributes, encapsulation, Inheritance, Polymorphism with programming examples.

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. Martin C Brown, "The complete reference, python", McGraw Hill.
2. David M Beazely, "Python essential reference", 4th edition.

Course outcomes:
On completion of the course, the student will be able to:

Course Code	CO #	Course Outcome (CO)
21ECX36A	CO1	Develop basic python programming skills.
	CO2	Develop Programs with control structures and functions.
	CO3	Write programs to analyze string and list operations.
	CO4	Write programs to show operations on dictionaries, tuples and files.
	CO5	Develop program to implement the OOPs principles.

21ECAE36A: Python Programming

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop basic python programming skills.	3	2	2		3							3	2		
CO2	Develop Programs with control structures and functions.	3	3	3		3							3	3	2	2
CO3	Write programs to analyze string and list operations.	3	3	3		3							3	3	2	2
CO4	Write programs to show operations on dictionaries, tuples and files.	3	2	3		3							3	3	3	2
CO5	Develop program to implement the OOPs principles.	3	3	3		3							3	3	3	3
Average		3	2.6	2.8			3						3	2.6	2.5	2.2

ELECTRONIC CIRCUITS-I LAB		
Subject Code	21ECL31	CIE: 50
Number of LectureHours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS–1		

Course objectives:

- To implement rectifier and filter circuits.
- Gain knowledge of wave shaping circuits
- To Understand transistor amplifier circuits
- To design and implement different oscillators
- To design and implement feedback amplifiers

1. Full-wave rectifier with/without capacitor filter.
2. Series and Parallel clipping circuits
3. Clamping circuits
4. Zener voltage regulator
5. Fixed-bias amplifier circuit using BJT.
6. Design and construct BJT CE amplifier using voltage divider bias with and without bypass emitter resistor.
7. Darlington amplifier
8. RC Phase shift oscillator using BJT.
9. Hartley and Colpitt's oscillator
10. Crystal oscillator
11. Design of a single stage voltage series feedback amplifier and draw frequency response.
12. Characteristics of SCR, UJT.
13. Step down chopper.

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 answerscript 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 be able to:

Course Code	CO #	Course Outcome (CO)
21ECL31	CO1	Analyse and design rectifiers, filters and wave shaping circuits.
	CO2	Design transistor amplifier circuits
	CO3	Design Darlington emitter follower circuit
	CO4	Design oscillators.
	CO5	Design feedback amplifier circuits.

21ECL31: Electronic Circuits-I Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse and design rectifiers, filters and wave shaping circuits.	3	3	1					2	3	2	1	1	3	2	2
CO2	Design transistor amplifier circuits	3	3	1					2	3	2	1	1	3	2	2
CO3	Design Darlington emitter follower circuit	3	3	2					2	3	2	1	1	3	2	2
CO4	Design oscillators.	3	3	2					2	3	2	1	1	3	2	2
CO5	Design feedback amplifier circuits.	3	3	2					2	3	2	1	1	3	2	2
Average		3	3	1.6					2	3	2	1	1	3	2	2

DIGITAL ELECTRONICS LAB		
Subject Code	21ECL32	CIE: 50
Number ofLectureHours/Week	02Hours (Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS–1.		

Course Objectives:

- Learn to realise Boolean Expressions
- Learn to design and realise Arithmetic circuits.
- Learn to design and realise Combinational circuits.
- Learn to design and realise Asynchronous counters.
- Learn to design and realise Synchronous counters, Shift Registers

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 implementation 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.

Course outcomes:
On completion of the course, the student will be able to:

Course Code:	CO #	Course Outcome (CO)
21ECL32	CO1	Simplify Boolean expressions and realize using logic gates.
	CO2	Design and implement combinational circuits using ICs.
	CO3	Design and implement asynchronous counters.
	CO4	Design and implement synchronous counters.
	CO5	Design and implement sequential circuits using shift registers.

21ECL32: Digital Electronics Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Simplify Boolean expressions and realize using logic gates.	2	2	1					2	3	2	1	1	3	2	2
CO2	Design and implement combinational circuits using ICs.	3	3	1					2	3	2	1	1	3	2	2
CO3	Design and implement asynchronous counters.	3	3	1					2	3	2	1	1	3	2	2
CO4	Design and implement synchronous counters.	3	3	1					2	3	2	1	1	3	2	2
CO5	Design and implement sequential circuits using shift registers.	3	3	1					2	3	2	1	1	3	2	2
Average		2.8	2.8	1					2	3	2	1	1	3	2	2

NETWORKS ANALYSIS LAB		
SubjectCode	21ECL33	CIE:50
Number of Lecture Hours/Week	02Hours(Practical)	SEE:50
Total Number of Lecture Hours	--	SEEHours: 03
CREDITS–1		

Course Objectives:

- Verification of network theorems
- Study of filters and resonant circuits
- Measurement of two-port network parameters
- Study of attenuators
- Study of steady state responses

1. Study of KCL, KVL.
2. Verification of Thevenin's and Norton's theorems
3. Verification of Superposition theorem.
4. Verification of Maximum Power transfer theorem.
5. Verification of Reciprocity and Millman's theorems.
6. Frequency Response of constant K low pass filter.
7. Frequency Response of constant K High pass filter.
8. Study of Series and Parallel Resonant circuits
9. Design and demonstration of working of T-type, π-type and lattice type attenuators.
10. Measurement of Z and Y parameters of a two port network.
11. Measurement of hybrid and Transmission parameters of a two port network.
12. Steady state analysis of RC and RL circuits

ConductofPracticalExamination:

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

Courseoutcomes:
On completion ofthecourse,thestudent willbe able to:

CourseCode	CO#	Course Outcome(CO)
21ECL33	CO1	Verify the KCL and KVL.
	CO2	Verification of network theorems.
	CO3	Design of resonance circuits.
	CO4	Implementing different passive filters and to analyse, steady state response of RC and RL networks.
	CO5	Analyse the Attenuators and to measure different parameters of a given two port network

21ECL33: Networks Analysis Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Verify the 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	Implementing different passive filters and to analyse, steady state response of RC and RL networks.	3	3	2			1	1	2	3	2		1	3	2	2
CO5	Analyse the Attenuators and to measure different parameters of a given two port network	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

SIGNALS AND SYSTEMS		
Subject Code	21EC41	CIE: 50
Number of LectureHours/Week	3 Hours (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3		

Course objectives:

- 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.

Module#	Teaching Hours
Module-1	**08 Hours**
Introduction: Continuous-Time and Discrete-Time Signals, Transformation of the independent variable, exponential and sinusoidal signals, the unit and unit step functions, Continuous -Time and Discrete-Time systems, basic system properties, singularity functions.	
Module-2	**09 Hours**
Linear Time-Invariant Systems: Discrete-time LTI systems, the convolution sum, continuous-time LTI systems, the convolution integral, properties of LTI systems, causal LTI systems described by differential and difference equations,	
Module-3	**08 Hours**
Fourier series representation of periodic signals: The response of LTI systems to complex exponentials, Fourier series representation of Continuous-Time periodic signals, convergence of the Fourier series, properties of Continuous-Time Fourier series, Fourier series representation of Discrete-Time periodic signals, properties of Discrete-Time Fourier series	
Module-4	**09 Hours**
Representation aperiodic signals: Continuous-Time Fourier Transform, the Fourier Transform for periodic signals, properties of continuous-Time Fourier transform, Discrete-Time Fourier Transform, the Fourier Transform for periodic signals, properties of Discrete-Time Fourier transform.	
Module-5	**08 Hours**
Sampling: Representation of Continuous-Time signals by its samples: the sampling theorem, Reconstruction of a signal from its samples using interpolation. **Z-Transforms:** The Z-Transform, region of convergence (ROC) and its properties, properties of Z-transforms, inverse Z-transform, Analysis and characterization of LTI systems using Z-Transforms, unilateral 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, 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.

Textbooks:

1. AllanV.Oppenheim,WilskyandS.H.Nawab,"SignalsandSystems",PearsonEducation,2007.
2. B. P. Lathi, "Communication Systems", John Wiley & Sons, 2001

Reference Books:

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

Ebooks and online course materials :NPTEL

Courseoutcomes:
On completion of the course, the student will be able to:

CourseCode	CO#	CourseOutcome(CO)
21EC41	**CO1**	Analyse different signals and operations on signals.
	CO2	Analyse LTI systems and determine properties of LTI Systems
	CO3	Represent the periodic signals in Fourier domain
	CO4	Represent the aperiodic signals in Fourier domain
	CO5	Analyse Discrete-Time signals using Z-Transform.

21EC41 : Signals and Systems

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse different signals and operations on signals.	3	3	2					1		1		1	3	3	2
CO2	Analyse LTI systems and determine properties of LTI Systems	3	3	2					1		1		1	3	3	2
CO3	Represent the periodic signals in Fourier domain	3	3	2		2			1		1		1	3	3	2
CO4	Represent the aperiodic signals in Fourier domain	3	3	2		2			1		1		1	3	3	2
CO5	Analyse Discrete-Time signals using Z-Transform.	3	3	2		2			1		1		1	3	3	2
Average		3	3	2		2			1		1		1	3	3	2

ELECTRONIC CIRCUIT-II		
Subject Code	21EC42	CIE: 50
Number of Lecture Hours/Week	3 (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3		

Course objectives:

- Basics of op-amp and its applications
- Generation of various waveforms
- Operation of data converters
- Timer Applications
- Regulators and its applications

Module#	Teaching Hours
Module-1	**09 Hours**

Op-amp Basics: Block diagram of Op-Amp. Analysis of differential amplifier. common mode and differential mode gains, transfer characteristics, CMRR, I/P & O/P impedances, ideal op-amp characteristics,

Linear operational amplifier Applications: Difference amplifiers, summer, integrator, differentiator, V to I & I to V converters, op-amp feedback limiters using diodes, log and antilog amplifiers, analog multipliers, peak detectors, precision rectifiers, instrumentation amplifier.

Module-2	08 Hours

Non-linear operational amplifier Applications: Monostable and astablemultivibrators, comparators, Schmitt trigger using operational-amplifier.

Waveform generation: Triangular and rectangular wave generator, sine wave generation

Timers: Basic timer circuit, 555 timer used as monostable and astablemultivibrators, timer others applications.

Module-3	08 Hours

Data converters: Performance parameters, D/A converters, weighted binary type, ladder R–2R converters,

A/D converters: Performance parameters, types of A/D converters: V/t, V/f, counter ramp, flash type, successive approximation, dual slope.

Module-4	09 Hours

Active filters: All pass phase shifting circuits, first and second order low pass and high pass filters

P**LL:** Basic block diagram, phase detector/comparator, VCO, low pass filter, monolithic phase locked loop

PLL applications: Frequency multiplication/division, frequency translation, AM detection, FM detection

Module-5	08 Hours

DC voltage regulators: Analysis and design of series and shunt regulators using op-amp, IC Voltage regulators (78XX,79XX, LM217,LM237) ,723 general purpose regulators. **Switching regulators**: Basic concepts 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 and Shail B Jain, "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.
2. Sergio Franco,"Design with Operational Amplifiers and Analog Integrated Circuits", Tata Mc Graw-Hill,4th Edition,2016 (Unit I – V)

E books and online course materials: NPTEL

Course Outcomes:
On completion of the course, the student will be able to:

Course Code	CO #	Course Outcome (CO)
21EC42	CO1	Analyse Op-amp circuits and their applications.
	CO2	Design of waveform generators using Op-amp and timers.
	CO3	Determine performance parameters of data converters.
	CO4	Analyse PLL operation and its applications.
	CO5	Design of voltage regulators.

21EC42 : Electronic Circuit-II

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse Op-amp circuits and their applications	3	3	3					1		1		1	3	2	2
CO2	Design of waveform generators using Op-amp and timers	3	3	3					1		1		1	3	2	2
CO3	Determine performance parameters of data converters	3	3	2					1		1		1	3	2	2
CO4	Analyse PLL operation and its applications	3	3	2					1		1		1	3	2	2
CO5	Design of voltage regulators	3	3	2					1		1		1	3	2	2
Average		3	3	2.4					1		1		1	3	2	2

DATA STRUCTURES AND OBJECT-ORIENTED PROGRAMMING USING C++		
Subject Code	21EC43	CIE: 50
Number of LectureHours/Week	03 Hrs. (Theory)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 3		

Course Objectives:

- 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.
- To able to understand Trees, Queues

Module#	Teaching Hours
Module-1	**09 Hours**
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.	
Module-2	**08 Hours**
Advanced object-oriented programming: Inheritance, Extending classes, Pointers, Virtual functions and polymorphism, File Handling Templates, Exception handling, Dynamic memory allocation.	
Module-3	**08 Hours**
Data Structures: Data Representation, Introduction, Linear list, Array representation, Linked representation, Arrays and Matrices **Stacks:** Definition, ADT, Array representation, Linked representation, Applications.	
Module-4	**08 Hours**
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	
Module-5	**09 Hours**
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.	

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)**
21EC43	**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	Analyse binary trees and priority queues and demonstrate the same with application programs.

21EC43: Data Structures and Object-Oriented Programming Using C++

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply various C++ constructs such as classes, functions, function overloading and dynamic memory management to develop programs.	3	3	2		2			1		1		1	3	2	2
CO2	Develop programs using constructors, destructors, Inheritance to achieve code reusability and virtual functions to achieve run time polymorphism.	3	3	2		2			1		1		1	3	2	2
CO3	Demonstrate program illustrations with data representations and data structures.	3	3	2	2	1			1		1		1	3	2	2
CO4	Efficiently implement the concepts of Stacks, queues and Hashing.	3	3	2	2	1			1		1		1	3	2	2
CO5	Analyse binary trees and priority queues and demonstrate the same with application programs.	3	3	3	3	2			1		1		1	3	2	2
Average		3	3	2.2	2.3	1.8			1		1		1	3	2	2

EMBEDDED MICROCONTROLLER		
Subject Code	21EC44	CIE: 50
Number of LectureHours/Week	03 Hours (Theory)	SEE: 50
Total No of Lecture Hours	42	SEE Hours: 03
CREDITS-3		

Course Objectives:

- To study the architecture of 8051 microcontrollers, addressing modes and instruction set.
- To learn Programming of 8051 Microcontroller, External Memory Interface, Real world interface
- Study architecture of ARM Cortex M series and TM4C
- Study ARM fundamentals for basic programming
- Study various application modules.

Module#	Teaching Hours
Module-1	**08 Hours**
Introduction-A brief overview of Computer, Microprocessors, Microcontrollers, Embedded Systems. **8051 Microcontroller-**Internal Architecture, Internal ROM, Internal RAM, SFRs.Addressing Modes, Instruction Set.	
Module-2	**09 Hours**
Assembly Language Programming: Programming Examples on **8051.** **Interfacing to external memory-**Memory Address Decoding, 8051 Interfacing with External ROM, Data Memory Space. **Real-world interfacing of 8051(Direct)-** ADC/DAC interface. **Real-world interfacing of 8051 via 8255 PPI -S**tepper Motor Interface.	
Module-3	**09 Hours**
Introduction to Embedded system Introduction to ARM architecture and Cortex, Cortex M4F architecture, Features. Introduction to the TM4C family viz.TM4C123GH6PM Block diagram, Features, Applications, TM4C123GH6PM launch pad I/O ports, System Clocks and control, Address space, On-chip peripherals (analog and digital), Register sets, Addressing modes and Instruction set basics.	
Module-4	**08 Hours**
Microcontroller fundamentals for basic programming: I/O pin multiplexing, pull up/down registers, GPIO control, programming System registers, Watchdog Timer, need of low power for embedded systems, active vs Standby current consumption, Interrupts, Interrupt vector table, interrupt programming, Hibernation Module, Toggling Multicolor LED.	
Module-5	**08 Hours**
Introduction to Timers, PWM and Mixed Signal Processing General-Purpose Timer Module (GPTM) block diagram, Basic Timers/Counters, Real Time Clock (RTC),Timing Generation and Measurement, Analog to Digital Converter (ADC), Analog Comparators, Analog Interfacing and Data Acquisition, Direct Memory Access (DMA), Pulse Width Modulation, Quadrature Encoder Interface (QEI),	

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 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 Second edition, Pearson Education,1999
2. Ti Tiva Arm Programming for Embedded Systems: Programming Arm Cortex-M4 TM4C123G with C (Mazidi&Naimi Arm) Publisher : ;Micro digitaledFirst Edition (21 April 2017)ISBN 099-7925922
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. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers, 2014, Create space publications ISBN: 978-1463590154.
3. CC3100/CC3200 Simple Link™ Wi-Fi® Internet-on-a-Chip User Guide Texas Instruments Literature Number: SWRU368A April 2014- Revised August 2015.

E books and online course materials:

1. https://onlinecourses.nptel.ac.in
2. www.keil.com
3. https://onlinecourses.nptel.ac.in/noc21_ee18/preview
4. https://www.ti.com/seclit/ml/ssqu017/ssqu017.pdf
5. http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded_Processors
6. http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop
7. http://www.ti.com/ww/en/simplelinkembeddedwi-fi/home.html

Course Code	CO #	Course Outcome (CO)
21EC44	CO1	Analyse Intel 8051 Microcontroller Architecture, Addressing Modes, and Instructions.
	CO2	Program 8051 microcontroller, interface Real-world application
	CO3	Analyse the architecture of ARM and TM4C microcontroller
	CO4	Program TM4C Microcontroller
	CO5	Interface application modules to TM4C microcontroller

21EC44: Embedded Microcontroller

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse Intel 8051 Microcontroller Architecture, Addressing Modes, and Instructions.	2	2	2					1				2	2	2	2
CO2	Program 8051 microcontroller, interface Real-world application	2	2	2					1				3	2	3	3
CO3	Analyse the architecture of ARM and TM4C microcontroller	2	2	2					1				3	3	3	3
CO4	Program TM4C Microcontroller	2	2	2					1				3	3	3	3
CO5	Interface application modules to TM4C microcontroller	2	2	2					1				2	2	2	2
Average		2	2	2					1				2.6	2.4	2.6	2.6

VERILOG HDL PROGRAMMING		
Subject Code	21ECAE46B	CIE: 50
Number of LectureHours/Week	02 Hrs(Theory)	SEE: 50
Total Number of Lecture Hours	28	SEE Hours: 03
CREDITS- 4		

Course Objectives:

- Understand the basics of Verilog HDL.
- Lear to program using Data flow description.
- Learn to program using behavioural description
- Learn to program using Structural description
- Develop real time applications with Verilog HDL

Module#	Teaching Hours
Module-1	**5 Hours**
Introduction: Why HDL? , A Brief History of HDL, Structure of Verilog HDL Module, Operators, Data types, Types of Descriptions.	
Modules-2	**6 Hours**
Dataflow Descriptions: Structure of Data-Flow Description, Data Type –Vectors. Programming examples using data flow description.	
Modules-3	**6 Hours**
Behavioral Descriptions: Structure of HDL Behavioral Description, variable assignment Statement, sequential statements. Programming examples using behavioral flow description.	
Modules-4	**6 Hours**
Gate Level Descriptions: Organization of the gate Level description, Generate, Generic, and Parameter statements. Programming examples using Gate level description.	
Modules-5	**5 Hours**
Procedures, Tasks, and Functions: Procedures, tasks, and Functions, Programming examples to show real world 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.
- 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. Nazeih M. Botros, "HDL Programming VHDL and Verilog.
2. 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.

21ECAE46B: Verilog HDL Programming

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Realize the fundamental digital logic circuits using various Verilog HDL descriptions.	3	2	2		2							3	2		
CO2	Design and develop combinational logic circuits using Verilog HDL.	3	3	3		2							3	3	2	2
CO3	Analyse and verify the operation various flip flops using Verilog HDL.	3	3	3		2							3	3	2	2
CO4	Develop and design counters using Verilog HDL.	3	2	3		3							3	3	3	2
CO5	Develop Verilog HDL descriptions for real time applications.	3	3	3		3							3	3	3	3
Average		3	3	2.8		2.5							3	2.8	2.5	3

ELECTRONIC CIRCUIT-II LAB

Subject Code	21ECL41	CIE: 50
Number of LectureHours/Week	02 Hours(Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03

CREDITS–1

Course objectives:

- Design and implement op-amp circuits
- Generation of various waveforms
- Operation of data converters
- Timer applications
- Regulators and its applications

1. Linear applications of Op-amp
   i) Voltage follower
   ii) Inverting and Non inverting amplifier.
   ii) Summing amplifier.
2. Linear applications of Op-amp
   i) Difference amplifier
   ii) Differentiator
   iii) Integrator
3. Non-linear application of Op-amp
   i) Volatge Comparator
   ii) Schmitt trigger
4. Monostable multivibrator using IC 741.
5. Astable (symmetrical and non-symmetrical) multivibrator using IC 741.
6. Precision half wave and full wave rectifies using IC 741.
7. Monstable operation using 555 timer
8. Astable operation using 555 timer (symmetrical and non-symmetrical).
9. DAC
10. ADC
11. PLL characteristics and applications
12. Voltage regulators using IC 723

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 be able to:

Course Code:	CO #	Course Outcome (CO)
21ECL41	CO1	Implement linear applications of op-amp.
	CO2	Implement non-linear applications of op-amp.
	CO3	Design and implement 555 timer application.
	CO4	Implement data converters.
	CO5	Design and implement voltage regulators.

21ECL41: Electronic Circuit-II Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Implement linear applications of op-amp.	3	2	2					2	3	2		1	3	2	2
CO2	Implement non-linear applications of op-amp.	3	2	2					2	3	2		1	3	2	2
CO3	Design and implement 555 timer application.	3	2	2					2	3	2		1	3	2	2
CO4	Implement data converters.	3	2	2					2	3	2		1	3	2	2
CO5	Design and implement voltage regulators.	3	2	2					2	3	2		1	3	2	2
Average		3	2	2					2	3	2		1	3	2	2

DATA STRUCTURES USING C++ LAB		
Subject Code	21ECL42	CIE: 50
Number of LectureHours/Week	02 Hours (Practical)	SEE: 50
Total Number of Lecture Hours	42	SEE Hours: 03
CREDITS- 1		

Course Objectives:

- 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
- To develop functions to implement min/max heap

1. Develop C++ program that uses a function to perform the following
    a. Create a node
    b. Implement a singly/doubly/circularly linked list of Integers
    c. C++ program for traversal of a linked list
    d. Find nth node in linked list
    e. 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
    a. Implement stack using linked list
    b. Implement stack using two queues
    c. Implement simple stack operations to find min elements
    d. Add/ delete elements (push and pop) from stack
    e. Solve the tower of Hanoi problem using recursion
    f. Convert a given infix expression into postfix expression using stack.
3. Develop C++ programs to perform the following on Queues
    a. Array implementation of queue
    b. Implement queue using linked list
    c. Implement queue using two stacks
    d. Implement circular queue
    e. Implement doubly ended queue
    f. Implement double ended queue ADT using an array using a singly/doubly linked list.
    g. find front and rear in a linked queue
4. Write a C++ program that uses function template to perform the following,
    a. Build a binary tree
    b. Traverse the tree in inorder/ preorder/ postorder
    c. Program to implement insertion/deletion from binary tree.
    d. Program to check binary tree is complete or not
    e. 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,
    a. Implement heap
    b. Implement Min/Max Heap/Binary heap
    c. Search for a key element in a list of sorted elements using binary search.

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 be able to:

Course Code	CO #	Course Code CO # Course Outcome (CO)
21ECL42	**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

21ECL42: Data structure using C++ Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Apply the knowledge of linked lists to design and develop solutions to given problems.	2	2	2										2	2	1
CO2	Design and develop Linear data structures like Linked Lists using dynamic memory allocation technique.	2	2	2										2	2	1
CO3	Apply the knowledge of linked lists to design and develop solutions to given problems.	2	2	2										2	2	
CO4	Design and develop Linear data structures like Stack, Queue using memory allocation techniques and explore their applications	3	2	3										2	2	
CO5	Apply the knowledge of dynamic memory allocation technique to develop and implement non-linear data structures like Trees, Heaps and their applications	2	2	2										2	2	
Average		2.2	2	2.2										2	2	1

EMBEDDED MICROCONTROLLER LAB		
Subject Code	21ECL43	CIE: 50
Number of Hours/Week	02 Hours (Practical)	SEE: 50
Total Number of Lecture Hours	--	SEE Hours: 03
CREDITS–1		

Course objectives:

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

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

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

1. Interfacing and Programming GPIO ports in 'C' using Tiva for LED Blinking
2. Interfacing and Programming GPIO ports in 'C' using Tiva for Switch 1
3. Interfacing and Programming GPIO ports in 'C' using Tiva for Switch 2
4. PWM generation using PWM module on Tiva
5. Interfacing Potentiometer with Tiva GPIO
6. Interrupt programming through GPIO
7. Speed control of DC motor controlled by potentiometer connected to Tiva GPIO
8. Hibernation and Wakeup on an RTC Interrupt

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 be able to:

Course Code	CO #	Course Outcome (CO)
21ECL43	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

21ECL43: Embedded Microcontroller Lab

CO#	COs	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. V to VIII SEMESTER

CURRICULUM FOR THE ACADEMIC YEAR

2021-22 to 2024-25

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING,

KALABURAGI-585102

(An Autonomous Institution, Affiliated to VTU, Belagavi)

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 in 1958.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 Defence 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

- To provide a high-quality educational experience for students with values and ethics that enables them to become leaders in their chosen profession.
- To explore, create and develop innovations in engineering and science through research and developmental activities.
- 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 Analyse 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 modelling 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 to engage 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.

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

Department of Electronics and Communication Engineering

(Effective from the academic year 2021-22)

V Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PC	21EC51	Linear Control Systems	ECE	3	0	0	-	03	50	50	100	3
2	IPCC	21EC52	Digital Signal Processing	ECE	3	0	2	-	03	50	50	100	4
3	PC	21EC53	Field Theory & Antennas	ECE	3	0	0	-	03	50	50	100	3
4	PC	21EC54	Analog and Digital Communication	ECE	3	0	0	-	03	50	50	100	3
5	PCL	21ECL55	Analog and Digital Communication Lab	ECE	0	0	2	-	03	50	50	100	1
6	AEC	21RMI56	Research Methodology and IPR	ECE	1	2	0	-	03	50	50	100	2
7	HSMS	21CIV57	Environmental Studies	CV/ME	0	2	0	-	03	50	50	100	1
8	AEC	21ECAE582	Introduction to Web Programming	ECE	0	2	0	-	02	50	50	100	1
Total										**450**	**450**	**800**	**18**

Ability Enhancement Courses					
SL. No.	Course Code	Course Title	SL. No.	Course Code	Course Title
1	21ECAE581	Communication SIMULINK Tool	2	21ECAE582	Introduction to Web Programming
3	21ECAE583		4	21ECAE584	

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

Department of Electronics and Communication Engineering

(Effective from the academic year 2021-22)

VI Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	HSMC	21HU61	Entrepreneurship Management and Finance	HSM	3	0	0	-	03	50	50	100	3
2	IPCC	21EC62	Microwave and Radar	ECE	3	0	2	-	03	50	50	100	4
3	PC	21EC63	VLSI Design	ECE	3	0	0	-	03	50	50	100	3
4	PEC	21EC64X	Professional Elective-I	ECE	3	0	0	-	03	50	50	100	3
5	OEC	21EC65OEX	Professional Open Elective - I	ECE	3	0	0	-	03	50	50	100	3
6	PCCL	21ECL66	VLSI Design Lab	ECE	0	0	2	-	03	50	50	100	1
7	MP	21ECMP67	Mini-Project	ECE	0	0	2	-	-	-	50	50	2
8	INT	21INT68	Innovation/ Entrepreneurship /Societal Internship (to be carried out during vacation of IV and V semesters)	ECE	-	-	-	-	-	-	50	50	3
Total										**300**	**400**	**700**	**22**

Professional Elective-I:

1. Information Theory & Coding
2. Adaptive Signal Processing
3. Speech Signal Processing

Professional Open Elective-I:

1. Computer Architecture & Organisation
2. Automotive Electronics
3. Robotics-I

LINEAR CONTROL SYSTEMS			
Course Code	21EC51	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students to:

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

Module-1	Teaching Hours
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.	9
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.	8
Module-3	
Concept of stability and algebraic criteria: The concept of stability, Necessary conditions for stability, Routh & Hurwitz stability criterions, Relative stability analysis. The Root Locus Technique: The Root Locus concept, Construction of Root Loci.	9
Module-4	
Frequency response analysis: Correlation between time and frequency response, Bode plots – General procedure for constructing Bode plots. Polar plots, Stability in frequency domain –Nyquist stability criteria, Assessment of relative stability using Nyquist criteria.	8
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.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

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

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)
21EC51	CO1	Analyze physical systems using differential equations, block diagrams and signal flow graphs.
	CO2	Analyze time response of first and second ordersystems.
	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.

21EC51: Linear Control Systems

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	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 ordersystems.	3	3	2					1		1		1	3	2	2
CO3	Construct the root locus and analyze the stability of thesystem 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 determine for observability and controllability.	3	3	2					1		1		1	3	2	3
Average		3	3	2		2			1		1		1	3	2	2.2

DIGITAL SIGNAL PROCESSING			
Course Code	21EC52	Credits	4
Course Type	Integrated	CIE Marks	50
Lecture Hours(L:T:P)	3:0:2	SEE Marks	50
Total Hours	42 (Theory)+14 Lab Slots	SEE Hours	3

Course objectives: This course will enable students to study:

- Basic concepts of digital signal processing.
- Analysis and processing of signals for different kind of applications and retrieval of information from signals.
- Design of digital filters and its realization.
- Analysis of signals using the discrete Fourier transforms (DFT) and Z-Transform.

Module	Teaching Hours
Module -1	
Discrete Fourier Transform: Representation of periodic sequences – The Discrete Fourier Series, Properties of DFS, Sampling the Z-transform, Fourier Representation of finite duration sequences – The Discrete Fourier Transform, Properties of DFT, Examples on DFT properties.	9
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.	8
Module -3	
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	9
Module -4	
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 Transforms.	8
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.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text book:

1. A.V.Oppenheim and R.W.Schafer, Digital Signal Processing, PHI.

Reference Books:

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

List of 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. Solution of difference equations.
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.
1. 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)
21EC52	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 Techniques.
	CO4	Design digital IIR filters from Analog filters.
	CO5	Realize digital filters using Network structures.

21EC52: Digital Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1																
CO2																
CO3																
CO4																
CO5																

FIELD THEORY AND ANTENNAS			
Course Code	21EC53	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

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

Module	Teaching Hours
Module-1	
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. **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, Laplace and Poisson's equations.	9
Module-2	
Magnetic Fields: Steady Magnetic fields: Biot savart's law, Ampere's circuital law, Curl. Stokes theorem, magnetic flux and flux density, magnetic force between differential current elements , magnetic boundary conditions **Time varying fields and Maxwell's equations**: Faraday's law, displacement current, Maxwell's equations in point form and integral form, the retarded potentials.	8
Module-3	
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.	8
Module-4	
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, Effectof earth on vertical pattern	8
Module-5	
Antenna Measurement: Methods of measuring impedance, field pattern, gain and directivity. **Antenna Types**: Yagi-Uda antenna, folded dipole antenna, parabolic reflectors, loop antenna, Helical antenna, horn antenna, patch antenna,slot antenna	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. William H Hayt Jr and John A Buck., Engineering electromagnetic, TMH 7th ed.
2. K D Prasad, Antenna and Wave propagation, Satyaprakashan Publishers,2012

Reference Books:

1. John D Kraus, Antennas, Third Edition, McGrawHill
2. Jordan and Balmain, Electromagnetic waves and radiating systems, Second Edition, PHI
3. C A Balanis, Antenna theory analysis and design, Third Edition, Wiley
4. E C Jordon & K G . Balmain., electromagnetic waves and radiation system., PHI2nd ed
5. Kraus J D and Carver K R., electromagnetic., (TMH)
6. P V Gupta., An Introduction Course in electromagnetic.
7. 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)
21EC53	CO1	Analyze the Electric fields due to different sources of electric fields
	CO2	Analyze Steady and time varying magnetic fields
	CO3	Determine the characteristic parameters of antennas
	CO4	Analyze antenna arrays.
	CO5	Illustrate the construction and working of different types of antennas.

21EC53: Field Theory and Antennas

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze the Electric fields due to different sources of electric fields	3	3	2					1		1		1	3	2	2
CO2	Analyze Steady and time varying magnetic fields	3	3	2					1		1		1	3	2	2
CO3	Determine the characteristic parameters of antennas	3	2						1		1		1	3	2	2
CO4	Analyze antenna arrays.	3	3	2	2				1		1		1	3	2	2
CO5	Illustrate the construction and working of different types of antennas.	3	2	2	2				1		1			3	2	3
	AVERAGE	3	2.6	2	2				1		1		1	3	2	2.2

ANALOG AND DIGITAL COMMUNICATION			
Course Code	21EC54	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

1. To introduce the concepts of analogue communication systems.
2. To equip students with various issues related to analogue communication such as modulation, demodulation.
3. To understand different PCM techniques and its analysis in terms of SNR.
4. To understand different carrier modulation techniques and its BER performance.
5. To study and understand properties of orthogonal codes and its use in spread spectrum communication

Modules	Teaching Hours
Module-1	
Amplitude Modulation: Amplitude modulation, double sideband, double sideband suppressed carrier modulation, SSB modulation, vestigial sideband modulation, costas receiver, quardrature-amplitude modulation.	**8**
Module-2	
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 **Radio Receivers**: Tuned radio frequency receiver, super heterodyne receiver- RF section, frequency mixers, tracking, intermediate frequency, AGC.	**9**
Module-3	
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, quantization noise in PCM, Companding in PCM systems, Time division multiplexing (TDM), The delta modulator and its operation, quantization noise and slope overload in delta modulators. Comparison of delta modulation and PCM.	**9**
Module-4	
Digital Modulation: PSK, DPSK and FSK. M-array data communication systems, QAM systems, four phase PSK effects of noise in modulated digital communication Systems, Probability of error expression for binary communications, probability of error in QAM systems, comparison of digital modulation systems.	**8**
Module-5	
Spread Spectrum Systems: PN sequence, PN sequence generation, Properties of PN sequence, 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.	**8**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.

- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

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. Simon Haykin, Digital Communications, John Wiley and Sons.
2. H.P.Hsu , Analog and Digital Communications, Schuam's outline series.
3. J G Proakis, Digital communications, MH.
4. B P Lathi, Modern Digital and Analog Communication, 3rd Edition.

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)
21EC54	**CO1**	Analyze different amplitude modulation and demodulation techniques.
	CO2	Analyze different angle modulation and demodulation techniques.
	CO3	Analyze different PCM techniques and its analysis in terms of SNR
	CO4	Analyze different carrier modulation techniques and its BER performance
	CO5	Analyze properties of orthogonal codes and its use in spread spectrum communication.

21EC54: Analog and Digital Communication

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze different amplitude modulation and demodulation techniques.	3	2	2	2				1		1		1	3	2	2
CO2	Analyze different angle modulation and demodulation techniques.	3	3	2	2				1		1		1	3	2	2
CO3	Analyze different PCM techniques and its analysis in terms of SNR	3	3	2	2				1		1		1	3	2	2
CO4	Analyze different carrier modulation techniques and its BER performance	3	3	2	2				1		1		1	3	2	2
CO5	Analyze properties of orthogonal codes and its use in spread spectrum communication.	3	2	2	2				1		1		1	3	2	2
Average		3	2.6	2	2				1		1		1	3	2	2

ANALOG & DIGITAL COMMUNICATION LAB			
Course Code	21ECL55	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To design and demonstrate second order active low pass, high pass, band pass filters
- To design and demonstrate analog and angle modulation.
- To design and demonstrate pulse modulation and demodulation.
- To design and demonstrate digital modulation and demodulation such ASK, PSK, DPSK and FSK.
- To verify and demonstrate PN sequence generation.

List of Experiments

1. Second order active low pass and high pass filter
2. Second order active band pass and band elimination filter
3. Amplitude modulation and demodulation using envelop detector
4. Frequency modulation and demodulation using PLL
5. Pre-emphasis and De-emphasis circuits.
6. PAM modulation and demodulation
7. PPM Modulation and demodulation
8. PWM Modulation and demodulation
9. Signal sampling and its reconstruction
10. Time division multiplexing of signals
11. Amplitude shift keying
12. Frequency shift keying
13. Phase shift keying
14. Differential phase shift keying
15. 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 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)
21ECL55	CO1	Design various second order active filters.
	CO2	Design AM, FM and its demodulation.
	CO3	Design pre-emphasis and de-emphasis.
	CO4	Design and implement ASK, FSK and PSK modulation and demodulation.
	CO5	Design and implement PN sequence generator.

21ECL55: Analog and Digital Communication Lab

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Design various second order active filters.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO2	Design AM, FM and its demodulation.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO3	Design pre-emphasis and de-emphasis.	3	2	2	2	2	1	1	2	3	2		1	3	3	2
CO4	Design and implement ASK, FSK and PSK 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

RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS			
Course Code	21RMI56	Credits	2
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	1:2:0	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students:

- To Understand the knowledge on basics of research and its types.
- To Learn the concept of defining research problem and Literature Review, Technical Reading.
- To learn the concept of attributions and citation and research design.
- Concepts, classification, need for protection, International regime of IPRs - WIPO, TRIPS, Patent - Meaning, Types, surrender, revocation, restoration, Infringement, Procedure for obtaining Patent and Patent Agents.
- Meaning, essential requirements, procedure for registration and Infringement of Industrial Designs, Copyright.

Modules	Teaching Hours
Module-1	
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship	**6**
Module-2	
Defining the research problem - Selecting the problem. Necessity of defining the problem Techniques involved in defining the problem- Importance of literature review in defining a problem Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet.	**6**
Module-3	
Research design and methods - Research design - Basic principles. Need of research design Features of good design- Important concepts relating to research design - Observation and Facts Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.	**6**
Module-4	
Basic Concepts of Intellectual Property (IP), Classification of IP, Need for Protection of IP, International regime of IPRs - WIPO , TRIPS. Patents: Meaning of a Patent – Characteristics/ Features. Patentable and Non-Patentable Invention. Procedure for obtaining Patent. Surrender of Patent, revocation &restoration of Patents, Infringement of Patents and related remedies (penalties) . Different prescribed forms used in Patent Act. Patent agentsqualifications and disqualifications Case studies on patents - Case study of Neem petent, Curcuma(Turmeric)patent and Basmati rice patent, Apple inc.v Samsung electronics co.Ltd	**5**

Module-5	
Industrial Design: Introduction to Industrial Designs. Essential requirements of Registration. Designs which are not registrable, who is entitled to seek Registration, Procedure for Registration of Designs Copy Right Meaning of Copy Right. Characteristics of Copyright. Who is Author, various rights of owner of Copyright. Procedure for registration. Term of copyright, Infringement of Copyright and Its remedies. Software Copyright.	**5**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Research Methodology: Methods and Techniques C.R.Kothari, Gaurav Garg New Age International 4th Edition,2018
2. Dipankar Deb•RajeebDey,ValentinaE.Balas "EngineeringResearchMethodology",ISSN1868- 4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13- 2946-3 ISBN 978-981-13-2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0.3
3. Dr. M.K. Bhandari"Law relating to Intellectual property" January 2017 (Publisher By Central Law Publications). Dr. R Radha Krishna and Dr. S Balasubramanain "Text book of Intellectual Property Right". First edition, New Delhi 2008. Excel books.
4. P Narayan "Text book of Intellectual Property Right". 2017 ,Publisher: Eastern Law House

Reference Books:

1. David V.Thiel"ResearchMethodsforEngineers"CambridgeUniversityPress,978-1-107-03488- 4-
2. Nishith Desai Associates - Intellectual property law in India – Legal, Regulatory & Tax

E books and online course materials:

- NPTEL: INTELLECTUAL PROPERTY by PROF.FEROZ ALI , Department of Humanities and Social Sciences IIT Madras https://nptel.ac.in/content/syllabus_pdf/109106137.pdf
- www.wipo.int
- www.ipindia.nic.in

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

Course Code	CO #	Course Outcome (CO)
21RMI56	**CO1**	To know them leaning of engineering research.
	CO2	To know the defining of research problem and procedure of Literature Review.
	CO3	To know the Attributions and Citations and research design.
	CO4	Highlights the basic Concepts and types of IPRs and Patents
	CO5	Analyse and verify the procedure for Registration of Industrial Designs & Copyrights

INTRODUCTION TO WEB PROGRAMMING			
Course Code	21ECAE582	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	2

Course Objectives: The objectives of the course is to enable students to:

- To use the syntax and semantics of HTML and XHTML.
- To develop different parts of a web page.
- To understand how CSS can enhance the design of a webpage.
- To create and apply CSS styling to a webpage.
- To get familiarity with the JavaScript language and understand Document Object Model handling of Java Script.

Modules	Teaching Hours
Module-1	
Traditional HTML and XHTML: First Look at HTML and XHTML, Hello HTML and XHTML World, HTML and XHTML: Version History, HTML and XHTML DTDs: The Specifications Up Close, (X)HTML Document Structure, Browsers and (X)HTML, The Rules of (X)HTML, Major Themes of (X)HTML, The Future of Markup—Two Paths?	5
Module-2	
HTML5: Hello HTML5, Loose Syntax Returns, XHTML5, HTML5: Embracing the Reality of Web Markup, Presentational Markup Removed and Redefined, HTML5 Document Structure Changes, Adding Semantics, HTML5's Open Media Effort, Client-Side Graphics with <canvas>, HTML5 Form Changes, Emerging Elements and Attributes to Support Web Applications	5
Module-3	
Cascading Style Sheets (CSS): Introduction, CSS Overview , CSS Rules, Example with Type Selectors and the Universal Selector, CSS Syntax and Style, Class Selectors, ID Selectors, span and div Elements, Cascading, style Attribute, style Container, External CSS Files, CSS Properties, Color Properties, RGB Values for Color, Opacity Values for Color, HSL and HSLA Values for Color, Font Properties, line-height Property, Text Properties, Border Properties, Element Box, padding Property, margin Property , Case Study: Description of a Small City's Core Area.	6
Module-4	
Tables and CSS, Links and Images: Table Elements, Formatting a Data Table: Borders, Alignment, and Padding, CSS Structural Pseudo- Class Selectors, thread and tbody Elements, Cell Spanning, Web Accessibility, CSS display Property with Table Values, a Element, Relative URLs, Navigation Within a Web Page, CSS for Links, Bitmap Image Formats: GIF, JPEG, PNG, img Element, Responsive Images, Positioning Images, Shortcut Icon, iframe Element.	6
Module-5	
Introduction to JavaScript: Functions, DOM, Forms, and Event Handlers: History of JavaScript, Hello World Web Page, Buttons, Functions, Variables, Identifiers, Assignment Statements and Objects, Document Object Model, Forms and How They're Processed: Client-Side Versus Server-Side, form Element, Controls, Text Control, Accessing a Form's Control Values, reset and focus Methods	6

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. HTML & CSS: The Complete Reference Thomas A. Powell, , Fifth Edition, Tata McGraw Hill.
2. Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, First Edition

Reference Books:

1. M Deitel, P.J. Deitel, A.B Goldberg, "Internet & World Wide Web How to H Program"-3rd Edition, Pearson Education/PHI, 2004.
2. Chris Bates, "Web Programming Building Internet Applications"- 3rd Edition, Wiley India, 2006.

E books and online course materials:

https://onlinecourses.swayam2.ac.in/aic20_sp11/preview

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

Course Code	CO #	Course Outcome (CO)
21ECAE582	CO1	Explain the historical context and justification for HTML over XHTML
	CO2	Develop HTML5 documents and adding various semantic markup tags
	CO3	Analyse various attributes, values and types of CSS
	CO4	Develop the ability to create own website for given assignment and also perform dynamic designing using CSS.
	CO5	Implement core constructs and event handling mechanisms of JavaScript.

21ECAE582: Introduction to Web Programming

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Explain the historical context and justification for HTML over XHTML	2	2	2	2				2		2		2			3
CO2	Develop HTML5 documents and adding various semantic markup tags	2	2	2	3				2		2		2			3
CO3	Analyse various attributes, values and types of CSS	2	2	3	3				2		2		2			3
CO4	Develop the ability to create own website for given assignment and also perform dynamic designing using CSS	2	2	3	3				2		2		2			3
CO5	Implement core constructs and event handling mechanisms of JavaScript.	2	2	2	3				2		2		2			3
Average		2	2	2.4	2.8				2		2		2			3

ENTREPRENEURSHIP, MANAGEMENT AND FINANCE			
Course Code	21HU61	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Learning Objectives: The objectives of the course is to enable students to:

- The Meaning, Functions, Characteristics, Types, Role and Barriers of Entrepreneurship, Government Support for Entrepreneurship
- Management – Meaning, nature, characteristics, scope , functions, role etc and 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.	9
Module-2	
Management: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management, Levels of Management, Henry Fayol - 14 Principles to Management , McKinsey's 7-S Model, Management by objective(MBO) – Meaning, process of MBO, benefits and drawbacks of MBO.	9
Module-3	
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 commercial banks, Trade Credit, Customer Advances etc)	8
Module-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	8
Module-5	
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)	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text books:

1. Financial Accounting -B S Raman- United Publishers Manglore, Maheswar S N & Maheswari S K-Vikas Publishing House. January 2018.
2. Management & Entrepreneurship- K R Phaneesh- Sudha Publications January 2018, Prof Manjunatha & Amit kumar G – laxmi Publication, January 2011. Veerbhadrappa Havina - Published by New Age International (P) Ltd., 2009.
3. Principles of Management First Edition (English, G. Murugesan), Laxmi Publications – New Delhi.
4. Management by Objectives (Mbo) in Enterprises: 21 December 2018 by Dr Wazir Ali Khan

Reference Books:

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

E books and online course materials:

1. https://nptel.ac.in/courses/110/106/110106141/
2. https://www.businessmanagementideas.com/notes/management-notes/notes-on-management-in-an-organisation/4669
3. https://vskub.ac.in/wp-content/uploads/2020/04/Unit-5-ppmb.pdf

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

Course Code	CO #	Course Outcome (CO)
21HU61	CO1	Develop Entrepreneurship skills
	CO2	Apply the concepts of management and Management By Objective(MBO)
	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

21HU61: Entrepreneurship, Management and Finance

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Develop Entrepreneurship skills	2					2	2	3	3	2	3	3	2		
CO2	Apply the concepts of management and Management By Objective(MBO)	2	1				1	2	3	3	3	3	2	2	1	
CO3	Prepare project report & choose different Source of Finance.	2					1	1	2	3	3	3	2	2		
CO4	Apply Fundamentals of Financial Accounting and interpret the final accounts	2					1	1	2	3	3	3	2	2		
CO5	Apply personnel management skills, Material and inventory control techniques	2					1	1	2	2	2	2	3	2		
Average		2	1				1.2	1.4	2.4	2.8	2.6	2.8	2.4	2	1	

MICROWAVES AND RADAR			
Course Code	21EC62	Credits	4
Course Type	Integrated	CIE Marks	50
Lecture Hours(L:T:P)	3:0:2	SEE Marks	50
Total Hours	42 (Theory) + 14 Lab Slots	SEE Hours	3

Course Learning Objectives: The objectives of the course is to enable students to:

- 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	Teaching Hours
Module-1	
Microwave Waveguides And Components: Introduction, hybrid circuits, directional couplers, circulators, magic tee and isolators, phase shifters, attenuators, s-matrix representation of multiport networks.	9
Module-2	
Microwave Diodes: Transfer electron devices: Introduction: Avalanche transit time devices: READ diode, IMPATT diode, BARITT diode, parametric amplifiers and other diodes: PIN diodes, Schottky diodes. GUNN effect diodes – GaAs diodes, RWH theory, Modes of operation.	9
Module-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.	8
Module-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.	8
Module-5	
Tracking With Radar: Types of Tracking radar, mono pulse 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.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text books:

1. Microwave Devices and Circuits – Liao / Pearson Education
2. Microwave Engineering – Annapurna Das, Sisir K Das TMHPublication, 2001.

Reference Books:

1. Introduction to Radar Systems – Merrill I Skolnik, 3rd Ed,TMH, 2001.
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

List of Experiments:

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.

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

Course Code	CO #	Course Outcome (CO)
21EC62	CO1	Understand the basic concepts & functional characteristics of passive devices
	CO2	Understand the basic concepts & functional characteristics of Active devices
	CO3	Analyze the functional aspects of RADAR
	CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar
	CO5	Understand constructional aspects of different Radar Antennas and their functioning.

21EC62: Microwaves and Radar

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the basic concepts & functional characteristics of passive devices	2	1	1	1				1				2	3	1	1
CO2	Understand the basic concepts & functional characteristics of Active devices	2	1	1	1				1				2	3	1	1
CO3	Analyze the functional aspects of RADAR	2	2	1					1				2	2	1	1
CO4	Analyze the functional aspects of MTI and Pulse Doppler Radar	2	2	2	1				1				2	3	1	1
CO5	Understand constructional aspects of different Radar Antennas and their functioning.	1			1				1				2	3	2	1
Average		1.8	1.2	1	1				1				2	2.8	1.2	1

VLSI DESIGN			
Course Code	21EC63	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	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 designing and realizing the circuits in CMOS technology
- Cultivate the concepts of subsystem design processes.
- Demonstrate the concepts of CMOS testing

Modules	Teaching Hours
Module-1	
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**
Module-2	
Circuit Design Processes: MOS layers. Stick Diagrams. Design rules and layout – lambda-based design and other rules. **Logic Design with MOSFET:** Basic logic gates and complex logic gates in CMOS, Transmission gates circuits, CMOS Design rules and NMOS Design rules.	**9**
Module-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**
Module-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**
Module-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**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question

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: NPTEL

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

Course Code	CO #	Course Outcome (CO)
21EC63	CO1	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

21EC63: VLSI Design

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	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

INFORMATION THEORY AND CODING			
Course Code	21EC641	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course Objectives: The objectives of the course is to enable students to:

- Introduce the basic concepts of information theory.
- Analyze the channel capacity of discrete channels.
- Analyze the error control strategies.
- Analyze different coding and decoding techniques.

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	8
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,	9
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	9
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.	8
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.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

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

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)
21EC641	**CO1**	Understand the basic notion of information theory
	CO2	Determine the channel capacity
	CO3	Analyze the error control strategies
	CO4	Analyze various coding techniques.
	CO5	Analyze decoding techniques

21EC641: Information Theory and Coding

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the basic notion of information theory	3	2										1	3		
CO2	Determine the channel capacity	3	2										1	3		
CO3	Analyze the 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
Average		3	2.6	3		2							1	3	2	2

ADAPTIVE SIGNAL PROCESSING			
Course Code	21EC642	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	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 beam forming, four classes of application Stochastic process and models: Discrete time stochastic process, mean ergodic theorem, correlation matrix, stochastic models, word decomposition, autoregressive process, Yule –walker	9
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.	8
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	8
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	9
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	**8**

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.

- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

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)
21EC642	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

21EC642: Adaptive Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	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

SPEECH SIGNAL PROCESSING			
Course Code	21EC643	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans.
- To describe basic algorithms of speech analysis common to many applications.
- 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.	9
Module -2	
Speech Analysis – Time and frequency domain analysis of speech, speech parameter estimation, Linear prediction.	8
Module -3	
Speech compression – quality measures, waveform coding, source coders, Speech compression standards for personal communication systems	8
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.	8
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.	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.

Reference Books:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.
2. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.
3. 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)**
21EC643	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.

21EC643: Speech Signal Processing

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze mechanisms of human speech production and how the articulation mode of different classes of speech sounds determines their acoustic characteristics	2	3		3								2	3	3	2
CO2	Analyze and design 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
Average		2.8	2.8	2.5	2.8	2.75							2	3	2.2	1.4

COMPUTER ARCHITECTURE AND ORGANIZATION			
Course Code	21EC65OE1	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To introduce design concepts of processor and control unit design.
- To introduce the concepts of memory organization.
- To introduce the concept of parallel computing.

Modules	Teaching Hours
Module -1	
Processor Design: Processor organization, Information representation, number formats, Instruction sets – Instruction formats, Instruction types, assembly language programming, Fixed point arithmetic – addition, subtraction, multiplication and division, ALU Design – basic ALU organization, floating point arithmetic, arithmetic processors.	9
Module -2	
Control Design: Instruction sequencing, Instruction interpretation, Hardwired Control – Design methods, multiplier control unit, CPU control unit, Microprogrammed control – basic concepts, control memory organization multiplier control unit.	8
Module -3	
Memory organization: Memory Technology – memory device characteristics, random access memories, serial access memories, Virtual memories – memory hierarchies, main memory allocation, segments, pages and files.	9
Module -4	
System organization: Communication – Bus control, computer networks, I/O systems – programmed IO, DMA and interrupts, IO processors.	8
Module -5	
Parallel Processing: Basic concepts – Types of parallel processors, performance considerations, Pipeline processors – pipeline structures, vector super computers, Multiprocessor architectures.	8

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.
- Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. John P Hayes, Computer architecture and Organization, Mcgraw-Hill ,2nd Edition-1988.
2. William Stallings, Computer organization and architecture, Pearson, 7th Edition, 2006.

Reference Books:

1. Kai Hwang, Faye a.Briggs, Computer architecture and parallel processing, MacGraw-Hill 1985.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21EC65OE1	CO1	Analyze and Design ALU Circuits and processors. Represent numbers in different formats.
	CO2	Design control units to interface with Multiplexers and other input and output devices.
	CO3	Estimate memory requirements and interface with different memories.
	CO4	Interface interrupts, I/O devices and design computer networks.
	CO5	Analyze pipelined, parallel and multi processors and their processing.

21EC65OE1: Computer Architecture And Organization

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze and Design ALU Circuits and processors. Represent numbers in different formats.	2	3		3								2	3	3	2
CO2	Design control units to interface with Multiplexers and other input and output devices.	3	2		3	3							2	3	2	1
CO3	Estimate memory requirements and interface with different memories.	3	3		2	2							2	3	2	1
CO4	Interface interrupts, I/O devices and design computer networks.	3	3	2	3	3							2	3	2	2
CO5	Analyze pipelined, parallel and multi processors and their processing.	3	3	3	3	3							2	3	2	1
Average		2.8	2.8	2.5	2.8	2.75							2	3	2.2	1.4

AUTOMOTIVE ELECTRONICS			
Course Code	21EC65OE2	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students:

- To analyse the functioning of different automotive components.
- To understand the operation of different automotive networks.
- To understand the add-on features of current automotive systems.

Modules	Teaching Hours
Module -1	
Automotive Fundamentals Overview-Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine - Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System, Starter Battery --Operating principle: **The Basics of Electronic Engine Control-**Motivation for Electronic Engine Control- Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.	9
Module -2	
Automotive Sensors -Automotive Control System applications of Sensors and Actuators - Variables to be measured, Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (02/EGO) Lambda Sensors, Piezoelectric Knock Sensor. **Automotive Engine Control Actuators-**Solenoid, Fuel Injector, EGR Actuator, Ignition System	8
Module -3	
Digital Engine Control Systems - Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control -Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System- Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, System Diagnostics. **Control Units-** Operating conditions, Design, Data processing, Programming, Digital modules in the Control unit, Control unit software.	8
Module -4	
Automotive Networking - Bus Systems- Classification, Applications in the vehicle, Coupling of networks, Examples of networked vehicles, Buses - CAN Bus, UN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces **Vehicle Motion Control -** Typical Cruise Control System, Digital Cruise Control	8

System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System (ABS)	
Module -5	
Automotive Diagnostics - Timing Light, Engine Analyzer, On-board diagnostics, Off-board diagnostics, Expert Systems, Occupant Protection Systems -Accelerometer based Air Bag systems. **Future Automotive Electronic Systems**-Alternative Fuel Engines, Electric and Hybrid vehicles, Fuel cell powered cars, Collision Avoidance Radar warning Systems, Low tyre pressure warning system, Heads Up display, Speech Synthesis, Navigation - Navigation Sensors - Radio Navigation, Signpost navigation, dead reckoning navigation, Voice Recognition Cell Phone dialing, Advanced Cruise Control, Stability Augmentation, Automatic driving Control	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch GmbH (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley & Sons Inc., 2007.

Reference Books:

1. "Design Methods of Safety-Critical Electronic Automotive Systems" by FulepTimea
2. "Automotive Electronic Diagnostics" by Mandy Concepcion

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

Course Code	CO #	Course Outcome (CO)
21EC65OE2	CO1	Describe the basics of automobile dynamics and design electronics.
	CO2	Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry.
	CO3	Use available automotive sensors and actuators while interfacing with microcontrollers/ microprocessors during automotive system design.
	CO4	Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the sub systems
	CO5	Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

21EC65OE2: Automotive Electronics

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1																
CO2																
CO3																
CO4																
CO5																
Average																

ROBOTICS-I			
Course Code	21EC65OE3	Credits	3
Course Type	Theory	CIE Marks	50
Lecture Hours(L:T:P)	3:0:0	SEE Marks	50
Total Hours	42	SEE Hours	3

Course objectives: This course will enable students to:

- Identify basic components of robot system and its functionality
- Identify the representation of robot and homogenous transformation of various arm configurations.
- Analyze the functions of sensors in the robot.
- Evaluate and compare the use of robots in different applications.
- Recognize material handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

Modules	Teaching Hours
Module -1	
Overview On Robotics & SCADA: Introduction to robotics, history of robotics, robotic configuration, Different types, Various generations, Degrees of freedom, Anatomy of a robot. Classification of robots. **SCADA**: Introduction and brief history of SCADA, SCADA systems software, considerations and benefits of SCADA system.	9
Module -2	
Control Systems and Components: Basic control systems concepts and models, controllers, robot actuation and feedback components. **Robot end effectors:** Types of end effectors, mechanical grippers, other types of grippers, tools as end effectors, robot/end effectors interface, consideration in gripper selection and design. **Sensor in Robotics:** Transducer and sensors, sensors in robotics tactile sensor, proximity and range sensors.	8
Module -3	
Machine vision: Introduction to machine vision. The sensing and digitizing function of machine vision, image processing and analysis: image data reduction, segmentation, feature extraction, object recognition, robotic application. **Artificial Intelligence**: Goals of AI in research, AI techniques: knowledge representation, problem representation and problem solving and search techniques in problem solving.	8
Module -4	
Robot cell design and control: Robot cell layouts, multiple robots and machine interference. Other consideration in work cell design, work cell control, interlocks, error detection and recovery, work-cell controller. **Material transfer, machine loading/unloading:** General considerations in robot material handling material transfer application, machine loading and unloading.	8
Module -5	

Processing operations, Assembly & Inspection: Spot welding, continuous arc welding, spray coating, other processing operations using robots, Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote center compliance (RCC) device, assembly system configurations, designing for robotic assembly, inspection automation.	9

Question paper pattern:

- The question paper shall have five Module for 100 marks;
- Each full question carries 20 marks.
- Two questions to be set in each module (total ten questions).
- The candidate will have to answer one full question from each module.

Note: There can be a maximum of 4 subsections in each Question.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. Srinivas Medida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007. (http://www.pacontrol.com/download/Industri alAutomation-Pocket-Guide.pdf)
3. Roland Siegwart, Illah R. Nourbakhsh, and Davide Scaramuzza, "Introduction to Autonomous Mobile Robots", 2ndEdition, PHI, 2011.

Reference Books:

1. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992

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

Course Code	CO #	Course Outcome (CO)
21EC65OE3	CO1	Identify basic components of robot system and its functionality.
	CO2	Study various Control systems, end effectors and sensors of robot system.
	CO3	Analyze the Machine Vision and artificial intelligence techniques.
	CO4	Study robot cell design with controlling.
	CO5	Recognize the processing operations, assembly and inspection for robot system.

21EC65OE3: Robotics-I

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify basic components of robot system and its functionality.	1						2					2	2	2	2
CO2	Study various Control systems, end effectors and sensors of robot system.	1	2	2				2					2	2	2	2
CO3	Analyze the Machine Vision and artificial intelligence techniques.	1	2	2				2				2	2	2	2	2
CO4	Study robot cell design with controlling.	1	2	2	2			2				2	2	2	2	2
CO5	Recognize the processing operations, assembly and inspection for robot system.	1	2	2	2			2				2	2	2	3	2
Average		**1**	**2**	**2**	**2**			**2**				**2**	**2**	**2**	**2.2**	**2**

VLSI LAB			
Course Code	21ECL66	Credits	1
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course Objectives: The objectives of the course is to enable students to:

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

List of Experiments

1. Design and develop Schematic to simulate the following
2. Inverter
3. 2-input NAND and NOR gate
4. 3-input NAND and NOR gate
5. Transmission Gate
6. AND gate
7. OR gate
8. MUX/DEMUX
9. Design circuit for given expressions.
10. Draw the layout and simulate the following, also plot the transient response
    a. CMOS Inverter
    b. NAND
    c. AND
    d. OR
    e. XOR
    f. XNOR
    g. Buffer
11. Flip-flops
    a. R-S
    b. D-T
    c. J-K

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 mark s.

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21ECL66	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 using MOS transistor
	CO5	Develop layouts to simulate sequential circuits using MOS transistor.

21ECL66: VLSI Design Lab

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	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 layouts to simulate combinational circuits using transmission gates.	3	1	1	1	3				2			1	3	2	3
CO4	Develop layouts to simulate combinational circuits using MOS 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

MINI-PROJECT			
Course Code	21ECMP67	Credits	2
Course Type	Practical	CIE Marks	50
Lecture Hours(L:T:P)	0:0:2	SEE Marks	50
Total Hours	28	SEE Hours	3

Course objectives: This course will enable students:

- 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.

Conduct of Practical Examination:

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

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

Course Code	CO #	Course Outcome (CO)
21ECMP67	CO1	Implement the layout/schematic (Design) .
	CO2	Testing of the individual modules.
	CO3	Record the results and analyze.
	CO4	Perform the review
	CO5	Demonstration of the work done (Viva Voce)

21ECMP67: Mini-Project

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Implement the layout/ schematic (Design)	3	3	2	1	3				3		3	1	2	2	
CO2	Testing of the individual modules.	2	2			2				3			1	2	2	
CO3	Record the results and analyze.	2	3			2		2		3			1	2	2	
CO4	Perform the review									3	3					
CO5	Demonstration of the work done (Viva Voce)	1	1		1	2	3	3	3	3	3	3	1	2	2	2
Average		2	2.2	2	1	2.2	3	2.5	3	3	3	3	1	2	2	2

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

BE in Electronics and Communication Engineering

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

VII Semester

Sl. No.	Course	Course Code	Course Title`	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	PEC-II	21EC71X	Professional Elective Course-II	ECE Dept	3	0	0	-	03	50	50	100	3
2	PEC-III	21EC72X	Professional Elective Course-III	ECE Dept	3	0	0	-	03	50	50	100	3
3	OEC-II	21EC73OEX	Open Elective – II	ECE Dept	3	0	0	-	03	50	50	100	3
4	OEC-III	21EC74OEX	Open Elective – III	ECE Dept	3	0	0	-	03	50	50	100	3
5	Project	21ECP75	Project Work	ECE Dept	0	0	3	-	03	50	50	100	10
6	AEC	21NPAE76	Online NPTEL Course (Min. 8 Weeks)	Swayam NPTEL						50	50	100	2
Total									**15**	**300**	**300**	**600**	**24**

Professional Elective-II:

- 21EC711-Computer Communication Networks
- 21EC712-Wireless Communication
- 21EC713-Satellite Communication
- 21EC714-Cryptography & Network Security

Professional Elective-III:

- 21EC721-Introduction to Machine Learning
- 21EC722-Introduction to Artificial Intelligence
- 21EC723-Cloud Computing

Open Elective-II:

- 21EC73OE1-Fundamentals of Telecommunication systems
- 21EC73OE2-Neural Network and Fuzzy Logic
- 21EC73OE3-Wireless Sensor Networks

Open Elective-III:

- 21EC74OE1-Biomedical Signal Processing
- 21EC74OE2-Mechatronics
- 21EC74OE3-Optimization Techniques

Computer Communication Networks		
Course Code	21EC711	CIE: 50
Credits	03	SEE: 50
Course Type	PEC– II	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To acquire knowledge of various Computer Network models, Topologies and Physical Layer.
- To study the duties and protocols of Data Link Layer.
- To study basics and applications of Wired Networks.
- To study the duties and protocols of Network Layer.
- To study the duties and protocols of Transport Layer and upper Layers.

Module-1	Teaching Hours
INTRODUCTION: The OSI model & layers in OSI model, TCP/IP protocol suite, Addressing, Functions of Physical Layer, Transmission Media, Transmission impairments, Data rate and its limits, Performance measures, Concepts of Switching and Multiplexing.	10
Module-2	
DATA LINK Layer: Framing, Addressing, Flow & Error Control, Protocols for Noiseless & Noisy Channels, Piggybacking. **Multiple Accesses Protocols:** Random Access protocols, Controlled Access protocols and Channelization protocols.	8
Module-3	
Wired LANs: Ethernet-IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, and Comparison. **Connecting Devices, Backbone Networks & Virtual LANs.**	8
Module-4	
NETWORK LAYER: Duties and Responsibilities- Logical Addressing-Classful and Classless Addressing, IPv4 protocol, IPv4 vsIPv6, Transition from IPv4 to IPv6, Routing-Unicastand Multicast Routing Protocols.	8
Module-5	
TRANSPORT LAYER: Duties-Addressing, Protocols-UDP, TCP, connection techniques. Overview of Upper Layer protocols. Overview of various social media platforms such as Facebook, Whatsapp, Twitter, Instagram.	8

***Case Study:** Study of a practical network in your institution or any organization.

(*Not for examination)

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 Publishers.

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.

Course Code	CO#	Course Outcome(CO)
21EC711	CO1	Identify the categories, Topologies and Network Models, and duties of Physical Layer
	CO2	Apply the concepts of Data Link Layer (DLL), functionalities and its protocols.
	CO3	Analyze the Ethernet structure and functioning of Wired LANs.
	CO4	Apply the concepts of Network Layer and its protocols and realize them.
	CO5	Apply the concepts of Transport Layer and its protocols, and Upper Layers.

CO-PO-PSO Matrix:

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the categories, Topologies and Network Models, and duties of Physical Layer.	3	2						1				2	2		
CO2	Describe the concepts of Data Link Layer (DLL) functionalities and its protocols.	3	2	1		2							1	2	1	
CO3	Analyze the Ethernet structure and functioning of Wired LAN.	3	1	1									1	2	1	
CO4	Describe the duties of Network Layer and functions of its protocols and realize them.	2	2	1		1							1	2	1	2
CO5	Identify the duties of Transport Layer and its protocols, and an overview of Upper Layers.	2	2	1		1						1	1	2	1	2
Average		**2.6**	**1.8**	**1**		**1.33**			**1**			**1**	**1.2**	**2**	**1**	**2**

Wireless Communication		
Course Code	21EC712	CIE: 50
Credits	03	SEE: 50
Course Type	PEC – II	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To impart knowledge of the concepts of wireless communication systems.
- To impart knowledge of mobile radio propagation models for large scale path loss.
- To impart knowledge of small scale fading and multi-path propagation.
- To impart knowledge of equalization, diversity techniques and the recent trends in wireless communication.
- To impart knowledge of important wireless systems, standards & latest developments in Wireless Systems.

Module-1	Teaching Hours
Introduction to wireless communication systems: Evolution of mobile radio communication. Examples of Wireless communication systems: Paging, Cordless and Cellular telephone systems. Comparison of common wireless communication systems. Evolution to 2.5G wireless networks. Introduction to 3G wireless networks. **Cellular concept and system design fundamentals:** Frequency reuse, Channel Assignment strategies, Hand off strategies, Iinterference and System Capacity, Trunking and Grade of service, improving Coverage and capacity in cellular Systems.	10
Module-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 model. Indoor Propagation models: Log distance path loss model.	8
Module-3	
Mobile Radio Propagation: Small-Scale Fading and Multi-path: Small scale multi-path propagation, Factors influencing small scale fading, Doppler shift, Impulse response model of a multi-path channel, Relationship between bandwidth and received power. **Types of small-scale fading:** Fading Effects Due to Multi-path Time Delay Spread: Flat & frequency selective fading. Fading effects due to Doppler spread: Fast & Slow fading, Rayleigh and Ricean distributions.	8
Module-4	
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. **Advanced Topics in Wireless Ccommunication:** MIMO & Massive MIMO Emerging Techniques for 5G, D2D, Millimeter wave communication, Content catching.	8
Module-5	
Wireless Systems & Standards: **GSM- S**ervices & features, System architecture, Radio sub system, Channel types,	

Example of GSM call. **PACS:** System architecture, Radio interface, Pacific Digital Cellular, Personal Handy Phone System.Latest Developments in Wireless Systems & Standards	8

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, 2nd edition.

E books and online course materials: NPTEL course material

Course outcomes:

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

Course Code	CO #	Course Outcome (CO)
21EC712	CO1	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 multi path.
	CO4	Analyze the various equalization and diversity techniques, Understand the recent topics in wireless communication.
	CO5	Analyze GSM, PAC & latest developments in wireless systems. & standards.

CO-PO-PSO Matrix:

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze the modern wireless communication systems and cellular concepts.	3	2	1									2	3	2	
CO2	Illustrate the effects of atmosphere on radio wave propagation during large scale.	3	3	2									2	3	2	2
CO3	Illustrate the effects of atmosphere on radio wave propagation during small scale fading and multi-path.	3	3	2									2	3	2	2
CO4	Analyze the various equalization and diversity techniques and also understand the recent topics in wireless communication.	3	3	2									2	3	2	2
CO5	Analyze GSM, PAC & latest developments in wireless systems & standards.	3	3	2									2	3	2	2
Average		**3**	**2.9**	**1.9**									**2**	**3**	**2**	**2**

Satellite Communication		
Course Code	21EC713	CIE: 50
Credits	03	SEE: 50
Course Type	PEC-II	
Number of Lecture Hours/Week	3 Hours(Theory)	Total Marks:100
Total Number of Lecture Hours	42	SEE Hours: 03

Course Objectives:

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

Module-1	Teaching Hours
Overview of satellite communication 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:** satelliteorbits, 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.	9
Module-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.	8
Module-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	8
Module-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.	8
Module-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, Ionospheric 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.	9

Course Code	CO #	Course Outcome (CO)
21EC713	CO1	Analyze the basic structure of satellite and orbital aspects.
	CO2	Apply the concepts of geostationary orbit and determination of look angles.
	CO3	Analyze the working principle, operation of various subsystems and earth station of satellite.
	CO4	Analyze and design the satellite communication link.
	CO5	Analyze the propagation effects and their impact on satellite-Earth links.

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. Dennis Roddy, "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, 2ndEdition 2007.
2. Raja Rao: Fundamentals of Satellite communications, PHI Learning.
3. MonojitMitra: Satellite Communication: PHI Learning.

CO-PO-PSO Matrix:

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyze the basic structure of satellite and orbital aspects.	1	1								1			2	1	
CO2	Apply the concepts of geostationary orbit and determination of look angles.	2	1	2	2		1	1		3	2	2	1	2	1	
CO3	Analyze the working principle, operation of various subsystems and earth station of satellite.	1		1				2			1		1	2	1	
CO4	Analyze and design the satellite communication link.	1	2	2	2		1	1		2	2	3	1	1	2	1
CO5	Analyze the propagation effects and their impact on satellite-Earth links.	1	1	1	1		1	1		2	2	2	1	1	2	1
Average		**1.2**	**1**	**1.2**	**1**		**0.6**	**1**		**1.4**	**1.4**	**1.4**	**0.8**	**1.6**	**1.4**	**0.4**

Cryptography and Network Security		
Course Code	21EC714	CIE: 50
Credits	03	SEE: 50
Course Type	PEC– II	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To impart knowledge of the basic concepts of encryption /decryption, classical encryption & block cipher techniques.
- To impart knowledge of Public-Key Cryptographic techniques, crypt-analysis & key management techniques.
- To impart knowledge of Message Authentication, Cryptographic Hash Functions, Digital Signature and Authentication Protocols & their applications.
- To impart knowledge of important Security Measures in Network based Applications.

Module -1	Teaching Hours
Overview: Need for information security, Services, Mechanisms and attacks, OSI security architecture, Model for network security, Cryptography, Cryptanalysis and Brute-Force Attack. **Classical Encryption Techniques:** Symmetric Cipher Model, , Substitution Techniques, Caesar Cipher, Mon alphabetic Cipher, Playfair Cipher, Hill Cipher, Polyalphabetic Cipher, One Time Pad(Vernam Cipher). **Block Ciphers and the Data Encryption Standard (DES) Algorithm:** Traditional block Cipher structure, stream Ciphers, Motivation for the Feistel Cipher structure, the Feistel Cipher, The Data Encryption Standard (DES) algorithm, Avalanche effect, Strength of DES, Timing attacks, Block cipher design principles.	9
Module -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.	9
Module-3	
Message Authentication and Cryptographic Hash Functions: Authentication Requirements and Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and MACs. **Digital Signature and Authentication Protocols:** Digital Signature Schemes and Authentication Protocols, Digital Signature Standard (DSS), Attacks.	8
Module-4	
Authentication Applications Entity/Message Authentication, Kerberos, Kerberos versions 4 and 5, X.509 authentication service, Kerberos Encryption technique, Problems.	8
Module-5	
Security in Network based Applications **Electronic Mail Security:** Pretty Good Privacy (PGP), S/MIME, Data Compression using ZIP, Radix-64 conversion, PGP random number generator. **IP Security:** Overview, IP security architecture, Authentication header, Encapsulating Security Pay Load (ESP), Security associations, Key management. **Firewalls:** Design principles, Trusted systems.	8

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.

Reference Books:

1. Behrouz Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd edition, Mc Graw Hill Education.
2. William Stallings, "Cryptography and Network Security", Pearson 6th edition.

E books and online course materials: NPTEL course material

Course outcomes:

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

Course Code	CO # Course Outcome (CO)
21EC714	Analyze the process of data encryption /decryption,classical encryption & block cipher techniques.
	Analyse the Public-Key Cryptographic techniques, Crypt-Analysis & Key Management Techniques.
	Analyse Message Authentication, Cryptographic Hash Functions, Digital Signature and Authentication Protocols.
	Analyse and apply Data Authentication for various applications.
	Apply important Security Measures in Network based Applications.

CO-PO-PSO Mapping:

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse the basics of encryption /decryption,classical encryption & block cipher techniques.	2	2	1										1	1	
CO2	Analyse Public-Key Cryptographic techniques, crypt-analysis & key management techniques.	2	2	2	1								1	2	2	
CO3	Analyse Messagee Authentication, Cryptographic Hash Functions, digital Signature and Authentication Protocols.	2	2	2									1	2	2	
CO4	Analyse and apply Authentication Applications.	2	2	2									1	2	2	
CO5	Apply important Security Measures in Network based Applications.	2	2	2			1						1			
Average		**2**	**2**	**1.8**	**1**		**1**						**1**	**1.75**	**1.75**	

Introduction to Machine Learning		
Course Code	21EC721	CIE: 50
Credits	03	SEE: 50
Course Type	Professional Elective III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks: 100
Total Number of Lecture Hours	42	SEE Hours: 03

Course Objectives:

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised and unsupervised
- Apply neural networks; Bayes classifier and k nearest neighbor, for problems appear in machine learning.
- Perform statistical analysis of machine learning techniques.

Modules	Teaching Hours
Module-1	
Introduction: Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. **Concept Learning:** Concept learning task, Concept learning as search, Find-S algorithm, Version space, Candidate Elimination algorithm, Inductive Bias.	8
Module-2	
Decision Tree Learning: Decision tree representation, Appropriate problems for decision tree learning, Basic decision tree learning algorithm, hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning	8
Module-3	
Artificial Neural Networks: Introduction, Neural Network representation, Appropriate problems, Perceptrons, Back propagation algorithm.	8
Module-4	
Evaluating Hypothesis: Motivation, Estimating hypothesis accuracy, Basics of sampling theorem, General approach for deriving confidence intervals, Difference in error of two hypothesis, Comparing learning algorithms. **Instance Based Learning:** Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, cased-based reasoning.	9
Module-5	
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm.	9

Text Books:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
2. Ethem Alpaydın, Introduction to machine learning, second edition, MIT press.

Course Code	CO #	Course Outcome (CO)
21EC721	CO1	Identify the problems for machine learning Investigate concept learning,
	CO2	Apply supervised learning for the given problem.
	CO3	Analyze the concept of Artificial Neural Networks ,Back Propagation algorithm
	CO4	Analyze the basics of learning problems with Hypothesis and Estimate function using Instance based learning
	CO5	Apply the concepts in Bayesian techniques and explore more about ML Classification .

CO-PO-PSO Mapping :

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Identify the problems for machine learning Investigate concept learning,	3	3	2		2								3	2	2
CO2	Apply supervised learning for the given problem.	3	3	3		2								3	2	2
CO3	Analyze the concept of Artificial Neural Networks ,Back Propagation algorithm	3	3	2		2								3	2	2
CO4	Analyze the basics of learning problems with Hypothesis and Estimate function using Instance based learning	3	2	2		2								3	2	2
CO5	Apply the concepts in Bayesian techniques and explore more about ML Classification .	3	2	3		2								3	2	2
Average		**3**	**2.6**	**2.4**		**2**								**3**	**2**	**2**

Introduction to Artificial Intelligence		
Course Code	21EC722	CIE: 50
Credits	03	SEE: 50
Course Type	Professional Elective III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks: 100
Total Number of Lecture Hours	42	SEE Hours: 03

Course Objectives:

- To impart knowledge of a given AI technique to a given problem
- To impart knowledge of non-trivial AI techniques in a relatively large system
- To impart knowledge of uncertainty and Problem solving techniques.
- To impart knowledge of various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
- To impart knowledge of semantic nets, frames, Scripts , CYC and Game playing.

Modules	Teaching Hours
Module-1	
Introduction to Artificial Intelligence: The AI Problems, The Underlying assumption, AI Technique, The Level of the model, Criteria for success. **Problems, problem spaces, and search:** Defining, the problem as a state space search, Production systems, Problem characteristics, Production system characteristics, Issues in the design of search programs.	9
Module-2	
Heuristic search techniques: Generate-and-test, Hill climbing, Best-first search, Problem reduction, Mean-ends analysis. **Knowledge representation issues:** Representations and mappings, Approaches to knowledge representation ,Issues in knowledge representation, the frame problem.	8
Module-3	
Using predicate logic: Representing simple facts in logic, representing instance and ISA relationships, Computable functions and predicates, Resolution, Natural Deduction **Representing Knowledge Using Rules:** Procedural versus Declarative knowledge, Logic programming, forward versus backward reasoning, matching, control knowledge.	8
Module-4	
Symbolic Reasoning Under Uncertainty: Introduction to non-monotonic reasoning, Logic for non-monotonic reasoning, Implementation Issues, Augmenting a Problem-Solver, Implementation: Depth-first search, Implementation: Breadth-first search. **Statistical Reasoning:** Probability and bayes Theorem, Certainty factors and rule-based systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy logic.	9
Module-5	
Weak Slots and filler structure: Semantic Nets, Frames **Strong Slot and Filler Structure:** Conceptual Dependency, Scripts, CYC. **Game playing:** The minimax search procedure, alpha beta cutoffs, Additional Refinements, Iterative Deepening..	8

Text Books:

1. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw-Hill, 3rd Edition 2008

Reference Books:

1.Stuart J. Russel and Peter Norvig: "Artificial Intelligence-A Modern Approach",4th Edition, Pearson Education, 2021.

2.George F. Lugar, Artificial Intelligence Structure and strategies for Complex, Pearson Education,5th Edition,2011
3.Saroj Kaushik, Artificial Intelligence, Cengage learnnig, 2014.

Course Code	CO #	Course Outcome (CO)
21EC722	CO1	Analyse AI technique and Problem solving techniques.
	CO2	Apply artificial intelligence search techniques, problem and heuristic search algorithm, symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
	CO3	Apply knowledge representation techniques and predicate Logic rules to solve reasoning programs.
	CO4	Analyze various symbolic reasoning under uncertainty in intelligent system development as well as understand the importance of maintaining intelligent systems.
	CO5	Describe semantic nets, frames, Scripts, CYC and Game playing.

CO-PO-PSO Mapping :

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Analyse AI technique and Problem solving techniques.	2	3	2		2								3	2	2
CO2	Apply artificial intelligence search techniques, problem and heuristic search algorithm, symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.	2	3	3		2								3	2	2
CO3	Apply knowledge representation techniques and predicate Logic rules to solve reasoning programs.	2	3	2		2								3	2	2
CO4	Analyze various symbolic reasoning under uncertainty in intelligent system development as well as understand the importance of maintaining intelligent systems.	3	2	2		2								3	2	2
CO5	Describe semantic nets, frames, Scripts, CYC and Game playing.	2	3	3		2								3	2	2
Average		**2.2**	**2.8**	**2.4**		**2**								**3**	**2**	**2**

Cloud Computing		
Course Code	21EC723	CIE Marks: 50
Credits	03	SEE Marks: 50
Course Type	Professional Elective III	
No. of Lecture Hours/Per Week (L:T:P)	3:0:0	Total marks: 100
Total Hours	42	SEE Hours: 3

Course Objectives:

- To impart knowledge of fundamentals of Cloud Computing
- To impart Concepts of Virtualization and the Cloud delivery and Deployment Models
- To impart knowledge of Cloud computing software security objectives, design principles and development practices
- To impart knowledge of Cloud computing risks, challenges and threats to infrastructure, data and access control.
- To impart knowledge of Cloud computing security architectural issues, Identity management and Autonomic security.

Modules	Teaching Hours
Module-1	
Cloud Computing fundamentals: Essential characteristics, Architectural Influences, Technological Influences, and Operational Influences.	8
Module-2	
Cloud Computing Architecture: Cloud Delivery models, The SPI Framework, Cloud Software as a Service (SaaS) , Cloud Platform as a Service(PaaS), Cloud Infrastructure as a Service(IaaS), Cloud deployment models, Public Clouds, Community Clouds, Hybrid Clouds, Alternative Deployment models, Expected benefits.	9
Module-3	
Cloud Computing Software Security fundamentals: Cloud Information Security Objectives, Confidentiality, Integrity, Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Secure Development practices, Approaches to Cloud Software Requirement Engineering, Cloud Security Policy Implementation.	9
Module-4	
Cloud Computing Risk Issues: The CIA Traid, Privacy and Compliance Risks, Threats to Infrastructure, Data and Access Control, Cloud Access Control Issues, Cloud Service Provider Risks. Cloud Computing Security challenges: Security Policy Implementation, Policy Types, and Computer Security Incident Response Team (CSIRT).	8
Module-5	
Cloud Computing Security Architecture: Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution environments and Communications, Micro architectures, Identity Management and Access Control, Autonomic Security.	8

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. Ronald L. Krutz, Russell Dean Vines, “Cloud Security A comprehensive Guide to secure Cloud Computing” Wiley.

REFERENCE BOOKS:

1. John Witinghouse james F.Ransome, "Cloud Computing Implementation, Management and Security" , CRC Press.
2. Borko Furht. Armando Escalante, "Handbook of Cloud Computing", Springer 3. Charles Badcock, "Cloud Revolution" , 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)
21EC723	CO1	Describe the main concepts, and key technologies of cloud computing and the possible applications for state-of-the-art cloud computing.
	CO2	Identify the architecture and infrastructure of cloud computing, with cloud delivery and deployment models.
	CO3	Analyze security, privacy, and interoperability issues of cloud computing.
	CO4	Identify problems, analyze, and evaluate various cloud computing solutions.
	CO5	Analyze appropriate cloud computing solutions and recommendations according to the applications used.

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe the main concepts, and key technologies of cloud computing and the possible applications for state-of-the-art cloud computing.	3	2	1										3	2	
CO2	Identify the architecture and infrastructure of cloud computing, with cloud delivery and deployment models.	3	2	1										3	2	2
CO3	Analyze security, privacy, and interoperability issues of cloud computing.	3	2	1		2								3	2	2
CO4	Identify problems, analyze, and evaluate various cloud computing solutions.	3	2	1		2								3	2	2
CO5	Analyze appropriate cloud computing solutions and recommendations according to the applications used.	3	2	1		2								3	2	2
Average		**3**	**2**	**1**		**2**								**3**	**2**	**2**

Fundamentals of Telecommunication Systems		
Course Code	21EC73OE1	CIE Marks: 50
Credits	03	SEE Marks: 50
Course Type	Open Elective - II	
No. of Lecture Hours/Per Week (L:T:P)	3:0:0	Total marks: 100
Total Hours	42	SEE Hours: 3

Course Objectives:

- To impart knowledge of Wireless telecommunication systems and networks and study different generations.
- To impart knowledge of Cellular concepts and cell fundamentals.
- To impart knowledge of GSM and TDMA techniques.
- To impart knowledge of CDMA technology and wireless modulation techniques.
- To impart knowledge of the concepts of LAN and MAN.

Modules	Teaching Hours
Module-1	
Introduction to Wireless TelecommunicationSystems and Networks: History and evolution, Different generations of wireless cellular networks 1G,2G, 3Gand 4G networks. **Common Cellular System and Network Components:** Hardware and software views of cellular networks,3G cellular systems components, Cellular component identification, Call establishment.	9
Module-2	
Wireless Network Architecture and Operation: Cellular concept, Cell fundamentals, Capacityexpansion techniques, Cellular backbone networks, Mobility management, Radio resources and Power management in Wireless networks.	9
Module-3	
GSM and TDMA Techniques: GSM system overview, GSM Network and System Architecture, GSM channel concepts, GSM identifiers, GSM system operation, Call handoffs, Roaming, GSM protocol architecture, TDMATechniques.	8
Module-4	
CDMA Technology: CDMA overview, CDMA channels concept, CDMA operations**,** Channel assignment strategies. **Wireless Modulation techniques:** Characteristics of air interface, Digital modulation techniques, OFDM, UWB radio techniques.	8
Module-5	
IntroductiontoWirelessLAN802.11XTechnologies: Evolution of Wireless LAN, Introduction to 802.15X technologies in PAN, Application and architecture of Bluetooth. Introductionto Broadband Wireless MAN.	8

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. WirelessTelecom SystemsandNetworks,Mullet:ThomsonLearning2006.

Reference Books:

1. Mobile Cellular Telecommunication, Lee W.C.Y, M G H,2002.
2. Wireless communication-D P Agrawal: 2nd Edition, Thomson learning2007.

3. Fundamentals of Wireless Communication, David T se, Pramod Viswanath,Cambridge2005
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)
21ECOE731	CO1	Describe wireless telecommunication systems, networks and different generations.
	CO2	Analyze network architecture, networks and also mobile management
	CO3	Describe GSM and TDMA techniques and the channel concept
	CO4	Analyze CDMA technology and its operation.
	CO5	Describe LAN, PAN and MAN Technologies.

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Describe wireless telecommunication systems, networks and different generations.	3	2	1										3	2	
CO2	Analyze network architecture, networks and also mobile management	3	2	1										3	2	2
CO3	Describe GSM and TDMA techniques and the channel concept	3	2	1		2								3	2	2
CO4	Analyze CDMA technology and its operation.	3	2	1		2								3	2	2
CO5	Describe LAN, PAN and MAN Technologies.	3	2	1		2								3	2	2
Average		**3**	**2**	**1**		**2**								**3**	**2**	**2**

Neural Networks and Fuzzy Logic		
Course Code	21EC73OE2	CIE: 50
Credits	03	SEE: 50
Course Type	Open Elective-II	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks: 100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To impart knowledge of core concepts of biological neural networks.
- To impart knowledge of the connection between biological and artificial neural networks and related ideas and methods.
- To impart knowledge of modern perspective on the fuzzy logic technology.
- To impart knowledge of neuro-fuzzy logic applications.

Module	Teaching Hours
Module-1	
Introduction: Biological neural networks, neuron physiology, forming networks and weighting factor. **Neural networks:** Basic model of a neuron, adaptive networks, architecture, back propagation for feed forward networks, hybrid learning rule: off-line learning, online learning.	9
Module-2	
Supervised learning neural networks: Introduction, perceptrons, logic operations with simple layer perceptrons, Exclusive-OR problem, multilayer perceptron, Delta learning algorithm, ADALINE (AdaptiveLinearNeuron) and MADALINE (Many ADALINE) models.	9
Module-3	
Unsupervised learning neural networks: Introduction, competitive learning networks, Kohen Self-Organization Networks, Hebian learning, Hopfield network, binary Hopfield networks, travelling sales person problem.	8
Module-4	
Fuzzy set theory: Fuzzy sets, representation of fuzzy sets, types of membership functions, law of excluded middle and law of contradiction, operations of fuzzy sets: intersection and union of fuzzy sets, complement of fuzzy set, Properties of fuzzy sets: The cardinality of fuzzy sets, height, normal verses sub normal, support and alpha-level cuts, resolution identity, convex fuzzy sets.	8
Module-5	
Fuzzy rules and fuzzy reasoning: fuzzy relations, composition of fuzzy relations, extension principle, fuzzy numbers, arithmetic operations on fuzzy numbers **Fuzzy-If-Then Rules**: basics of fuzzy rules, types of fuzzy rules, fuzzy mapping rule and fuzzy implication rule **Fuzzy inference systems**: Mamdani fuzzy models, The Takagi-Sugeno-Kang (TSK) models	8

Text Books:

1. Neuoro-Fuzzy & Soft Computing: A computational Approach to Learning and Machine Intelligence; J.- S. R. Jang, C.-T.Sun, and E.Mizutani, Pearson, 2nd Edition 2016.
2. Fuzzy Logic: Intelligence, Control. And Information; John Yen and Reza Langari, Pearson, 1st edition, 2007

Reference Books:

1. Understanding Neural Networks and Fuzzy Logic: Basic Concepts and Applications; Stamtios V. Kartalopaulous, PHI -IEEE Press, 2003

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 Code	CO #	Course Outcome (CO)
21ECOE732	CO1	Understand the concepts of biological neural networks and describe the basic model of artificial neural networks.
	CO2	Understand the process of supervised learning from the mathematical point of view.
	CO3	Know the process of unsupervised learning from the mathematical point of view.
	CO4	Understand the theoretical foundations of fuzzy logic systems through examples
	CO5	Apply fuzzy if then rules and fuzzy based models to suitable applications.

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Understand the concepts of biological neural networks and describe the basic model of artificial neural networks.	3	3										2			
CO2	Understand the process of supervised learning from the mathematical point of view.	3	3										2			
CO3	Know the process of unsupervised learning from the mathematical point of view.	3	3										2			
CO4	Understand the theoretical foundations of fuzzy logic systems through examples	3	3										2			
CO5	Apply fuzzy if then rules and fuzzy based models to suitable applications.	3	3										2			
Average		**3**	**3**										**2**			

Wireless Sensor Networks		
Course Code	21EC73OE3	CIE: 50
Credits	03	SEE: 50
Number of Lecture Hours/Week (L-T-P)	3-0-0 Open Elective - II	Total Marks:100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

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

Modules	Teaching Hours
Module-1	
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	8
Module-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.	9
Module-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, DataCentric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location-Based Routing, QoS-Based Routing Protocols.	9
Module-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.	8
Module-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.	8

Text Books:

1. Wattenegus Dargie 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. Kazem Sohraby, Daniel Minoli and Taieb Znati, "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)

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 Code	CO	Course Outcome(CO)
21ECOE733	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.

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	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**

Biomedical Signal Processing		
Course Code	21EC74OE1	CIE: 50
Credits	03	SEE: 50
Course Type	Open Elective-III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks: 100
Total Number of Lecture Hours	42 Hours (Theory)	SEE Hours: 03

Course Objectives:

- To impart knowledge of characteristics of biomedical signals
- To impart knowledge of artifact removal in biomedical signals
- To impart knowledge of event detection and waveform analysis of biomedical signals
- To impart knowledge of insight on pattern classification in biomedical signals
- To impart knowledge of insight to BCI

Modules	Teaching Hours
Module-1	
Introduction to Biomedical Signals: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. Electrocardiography: Basic electrocardiography, ECG leads systems, ECG signal characteristics. Signal Conversion: Simple signal conversion systems, Conversion requirements for biomedical signals, Signal conversion circuits.	9
Module-2	
Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging. Adaptive Noise Cancelling: Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering.	9
Module-3	
Cardiological signal processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG signal characteristics (parameters and their estimation), Analog filters, ECG amplifier, and QRS detector, Power spectrum of the ECG, Bandpass filtering techniques, Differentiation techniques, Template matching techniques, A QRS detection algorithm, Real-time ECG processing algorithm, ECG interpretation, ST segment analyzer, Portable arrhythmia monitor.	8
Module-4	
Neurological signal processing: The brain and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics (EEG rhythms, waves, and transients), Correlation. Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG, spike and wave detection.	8
Module-5	
Brain computer Interfacing: State of the art in BCI, ERD and ERS, Transient Beta activity after the movement, Gamma band oscillations, Long Delta activity, Major problems in BCI, Preprocessing of EEGs, Multidimensional EEG decomposition, Space time frequency method, Detection and separation of ERP signals, Estimation of cortical connectivity.	8

Text Books:

1. Rangayyan, Rangaraj M, Biomedical signal analysis, John Wiley & Sons, 2015
2. Saeid Sanei and J.A Chambers, EEG Signal processing, John Wiley, 2007

Reference Books:

2. Biomedical Digital Signal Processing- Willis J. Tompkins, PHI 2001
3. Biomedical Signal Processing Principles and Techniques- D C Reddy, McGraw- Hill publications 2005.

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 Code	CO #	Course Outcome (CO)
21ECOE741	CO1	Ability to understand concepts of signal processing
	CO2	Ability to apply algorithms for signal processing
	CO3	Ability to analyse biomedical signals and systems
	CO4	Ability to evaluate biomedical signal processing systems
	CO5	Ability to understand BCI

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Ability to understand concepts of signal processing	3	3										2	2	2	2
CO2	Ability to apply algorithms for signal processing	3	3										2	2	2	2
CO3	Ability to analyse biomedical signals and systems	3	3										2	2	2	2
CO4	Ability to evaluate biomedical signal processing systems	3	3										2	2	2	2
CO5	Ability to understand BCI	3	3										2	2	2	2
Average		3	3										2	2	2	2

MECHATRONICS		
Course Code	21EC74OE2	CIE: 50
Credits	03	SEE: 50
Course Type	Open Elective-III	
Number of Lecture Hours/Week (L-T-P)	3:0:0	Total Marks: 100
Total Number of Lecture Hours	42	SEE Hours: 03

Course Objectives

- To impart the key elements of mechanical system and sensor transducers.
- Understand the concepts of logical circuits.
- Analyze the various mechanical systems.
- Describe the significance of PLC for automation.
- Analyze the importance of communication systems

Modules	Teaching Hours
Module-1	
MECHATRONICS, SENSORS AND TRANSDUCERS: Introduction to Mechatronics Systems - Measurement Systems - Control Systems -Sensors and Transducers - Performance Terminology - Sensors for-Displacement, Velocity, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors, Selection of Sensors.	**8**
Modules-2	
DIGITAL LOGIC AND DATA PRESENTATION: Digital signals-Introduction,-BCD system-Analog and digital signals- Digital to analog conversion.-Logic Gates-,AND-OR-NOT-NAND-NOR-XOR, Applications-Coder-Encoder Decoder with seven segment display -LCD-(Traffic Light)-Sequential logic-,Flip Flops,-SR, JK, D Flip flops,-Registers- Data presentation system,-Display-Data presentation elements Types-Printers- Dot matrix, Laser printer, Data acquisition system, Selection criteria.	**9**
Modules-3	
ACTUATION SYSTEMS: Electrical Actuation Systems - Mechanical Switches - Solid State Switches-Types –Diode Power MOSFETs -Solenoids - D.C Motors-Basic working principle-Types- A.C Motors Basic working principle-Types - Stepper Motors- Basic working principle - List Types Stepper motor specifications Mechanical Actuation Systems - Ratchet and Pawl - Bearings.	**9**
Modules-4	
PROGRAMMABLE LOGIC CONTROLLERS: Introduction to Memories – RAM, ROM, PROM, EPROM, EEPROM, Microprocessor block diagram-Architecture of 8051, microcontroller- Architecture, pin configuration of Intel 8081, difference between microprocessor and microcontroller. Programmable Logic Controllers - Basic Structure - Input / Output Processing – Programming - ladder diagram Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogs Input / Output – Selection of PLC	**8**
Modules-5	
COMMUNICATION & DESIGN OF MECHATRONICS SYSTEM: Digital Communication Systems-Centralized, Hierarchical and Distributed Control Networks-Protocols-Open Systems Interconnection communication model-Communication Interfaces-Possible Design Solutions Case Studies of Mechatronics Systems,-Car Park barrier Systems - Engine Management Systems- Hard disc drive.	**8**

TEXT BOOK

1. W.Bolton "Mechatronics" , Pearson education

REFERENCE BOOKS:

1. Nitaigour Premch and Mahalik, "Mechatronics-Principle, Concepts and Applications"

Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006

Course Code	CO #	Course Outcome (CO)
21ECOE742	CO1	Discuss the importance of Mechatronics systems and know the usage of Sensors and Transducers for automation applications
	CO2	Acquire the knowledge of combinational and sequential logic circuits
	CO3	Analyze the various electro and mechanical systems available for automation
	CO4	Describe the significance of PLC for automation
	CO5	Analyze the importance of communication systems and its interface and Design the Mechatronics Systems.

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Discuss the importance of Mechatronics systems and know the usage of Sensors and Transducers for automation applications	1						2					2	2	2	1
CO2	Acquire the knowledge of combinational and sequential logic circuits	1	2	2				2					2	2	2	1
CO3	Analyze the various electro and mechanical systems available for automation	1	2	2				2				2	2	2	2	1
CO4	Describe the significance of PLC for automation	1	2	2	2			2				2	2	2	2	1
CO5	Analyze the importance of communication systems and its interface and Design the Mechatronics Systems.	1	2	2	2			2				2	2	2	2	1
Average		1	2	2	2			2				2	2	2	2	

Optimization Techniques		
Course Code	21EC74OE3	CIE: 50
Credits	03	SEE: 50
Course Type	Open Elective-III	
Number of Lecture Hours/Week (L-T-P)	3-0-0	Total Marks: 100
Total Number of Lecture Hours	42	SEE Hours: 03

Course Objectives:

- To impart knowledge of students to the modeling of constrained decision- making problems and optimization. This includes techniques of mathematical modeling, optimization, and sensitivity analysis.

Modules	Teaching Hours
Module-1	
Linear Programming: Introduction and formulation of linear programming problems, graphical solution of linear programming, simplex method, Big M method, Two Phase method.	9
Module-2	
Linear Programming: Special cases in simplex method application. Classical Optimization techniques: Introduction, unconstrained and constrained problems of maxima and minima, Lagrangian method.	9
Module-3	
Non Linear programming problems: Introduction, canonical form of nonlinear programming, formulation and graphical method, Kuhn-tucker conditions.	8
Module-4	
Dynamic programming: Decision tree and Belmann principle of optimality, concept of Dynamic programming, mathematical formulation of multistage decision models.	8
Module-5	
Fundamentals of queuing system: Poisson process, birth and death process, special queuing methods.	8

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 Code	CO #	Course Outcome (CO)
21ECOE743	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

CO-PO-PSO Mapping :

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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

Project Work			
Course Code	21ECP75	Credits	10
Course Type	PROJ	CIE	50
Lecture Hours (L:T:P)	0:0:3	SEE	50
Total Hours	13 Lab Slots	SEE Hours	50

Course Objectives:

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

Course Code	CO #	Course Outcome (CO)
21ECP75	**CO1**	Design the modules in par with the problem definition and objectives defined.
	CO2	Develop the modules and integrate them for implementation, fulfilling industrial or societal requirements.
	CO3	Develop the deployable proto type with sustainable and environmental friendly features.
	CO4	Demonstrate the product in team with appropriate budget justification.
	CO5	Prepare extensive documentation and publish the work.

CO#	CO Statement	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	Design the modules in par with the problem definition and objectives defined.	3	3	3					3					3		
CO2	Develop the modules and integrate them for implementation, fulfilling industrial or societal requirements.	2	3	3		3			3					3	3	
CO3	Develop the deployable proto type with sustainable and environmental friendly features.	2	3	3		3	3	3	3					3	3	3
CO4	Demonstrate the product in team with appropriate budget justification.	2							3	3	3	3				
CO5	Prepare extensive documentation and publish the work.								3	3	3					
Average		2.25	3	3		3	3	3	3	3	3	3		3	3	3

H. K. E. SOCIETY'S

POOJYA DODDAPPA APPA COLLEGE OF ENGINEERING, KALABURAGI

Choice Based Credit System (CBCS)

Scheme of Teaching and Examination 2021-22 to 2024-25

Department of Electronics and Communication Engineering

(Effective from the academic year 2021-22)

VIII Semester

Sl. No.	Course	Course Code	Course Title	Teaching Department	Teaching Hours/Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self-Study	Duration in hours	SEE Marks	CIE Marks	Total Marks	
1	Seminar	21ECS81	Technical Seminar		0	0	2		2		50	50	01
2	Internship	21INT82	Research/Industry Internship (16 Weeks)							50	50	100	15
Total										**50**	**100**	**150**	**16**

Note: AICTE Activity- 100 points for PU Students & 75 points for Lateral Students is Mandatory for Award of Degree

Seminar		
Course Code	21ECS81	CIE: 50
Credits	01	
Course Type	Seminar	
Lecture Hours (L:T:P)	0:0:2	Total marks: 50
Total Hours	-	

Course Objectives:

- To impart knowledge of recent technologies.
- To impart knowledge to Acquire detailed knowledge of the topic
- To impart knowledge of Documentation
- To impart knowledge of 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 Code	CO #	Course Outcome (CO)
21ECS81	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

21 ECS81: Seminar

CO#	Course Outcome (CO)	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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		2	3		3
Average		**3**	**2.66**		**2**		**2.33**			**3**	**3**		**2.8**	**3**	**2.5**	**3**